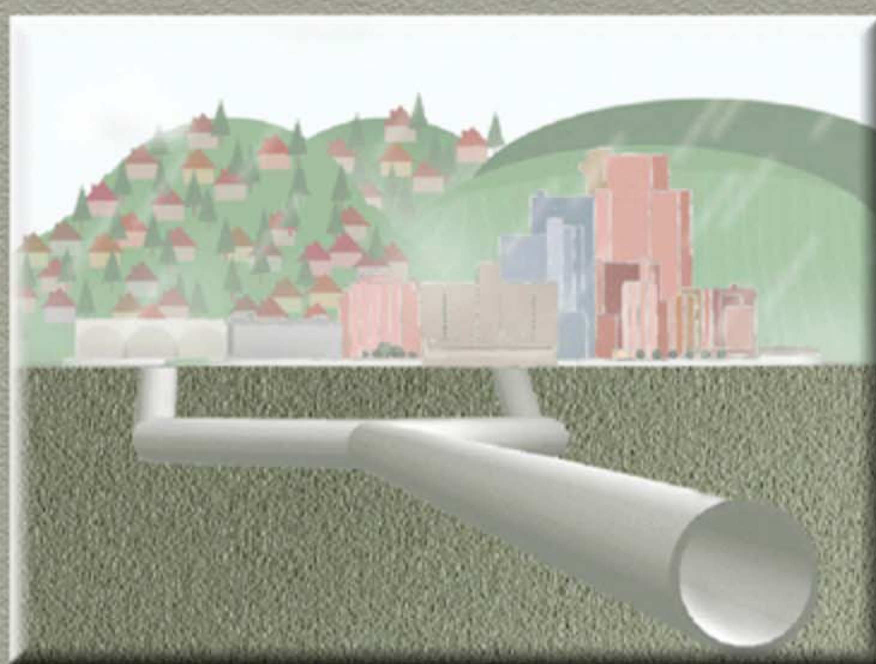
- CSI PROJECT -

GREEN RIVER NORTH SUBREGIONAL PLANNING AREA

TASK 250 A SUPPLEMENTAL REPORT
KENT AND AUBURN
FINAL COST REDUCTION AND PHASING SURCHARGE HYDRAULIC EVALUATION

December 2003



King County

Department of
Natural Resources and Parks
Wastewater Treatment Division

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Some pages in this document have been purposefully skipped or blank pages inserted so that this document will copy correctly when duplexed.

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FIGURES

INTRODUCTION

The Conveyance System Improvement Project (CSI) is a comprehensive evaluation of King County conveyance systems and an assessment of requirements to convey wastewater flows projected to the year 2050. The June 2001 Final Task 250 Supplement Report for the Mill Creek/Green River (MC/GR) Subregional Planning Area (SPA) presented working alternatives for increasing system capacity to convey 2050 flows. All modeling and sizing calculations for that analysis were based on the assumption that surcharge at manholes was not acceptable. The conveyance systems described in this Task 250A Supplement Report are located in Kent and Auburn and are part of the MC/GR SPA.

The purpose of this report is to determine potential for cost reductions by phasing the working alternatives presented in the June 2001 Final Task 250 Supplement Report. Additional studies are described below.

The June 2001 Final Task 240 Report evaluated two pipeline construction alternatives; paralleling existing sewers or re-routing flows to a new interceptor sewer west of SR-167 along the West Valley Highway. The Task 250A Supplement Report includes an additional alternative in which excess flows are re-routed to a new interceptor that parallels existing pipelines in most cases. In instances where the existing pipeline is paralleled, the existing pipeline is abandoned. This allows for use of existing capacity in the Auburn Interceptor III and phasing of proposed parallels to replace the existing Auburn Interceptors I and II.

Allowing limited amounts of surcharging may enable King County to postpone or eliminate working alternatives proposed for the Kent and Auburn portion of the MC/GR SPA. The wastewater conveyance systems in Kent and Auburn currently surcharges during significant storm events. Limited surcharging may be a viable system operating condition during storm events in the future. The Task 250A Supplement Report describes a surcharge hydraulic evaluation and investigates impacts to scope and budget of Kent and Auburn working alternatives presented in the June 2001 Final Task 250 Supplement Report by allowing surcharging.

After release of the June 2001 Final Task 250 report, King County produced updated flow projections for MC/GR based on a completed inflow and infiltration (I/I) study. These updated flow projections were used in the Task 250A Supplement Report and include interceptors sized to convey the entire 2050 flow. The interceptors included in the June 2001 Final Task 250 Supplement Report were sized to convey only a portion of the 2050 flow with the remainder of the 2050 flow conveyed by the existing pipelines. The Task 250A Supplement Report assumes total pipe replacement regardless of ultimate cost. It may be the case that a combination of paralleling and replacing interceptors serves the system better and reduces cost. This determination is beyond the scope of this report.

JUNE 2001 FINAL TASK 250 SUPPLEMENT REPORT

The June 2001 Final Task 250 Supplement Report presented working alternatives for the MC/GR SPA that are shown in Figure 1. The document was a planning level investigation through a design year of 2050. Wastewater conveyance projects presented in the document were referred to as working alternatives. Six working alternatives presented in the document to convey estimated flow:

- Southwest Interceptor
- 26^{th} Street Trunk
- Stuck River Trunk
- James Trunk
- Meeker Trunk
- Garrison Creek Relief Trunk.

The total project cost (construction, design, and planning) of the working alternatives presented in the June 2001 Final Task 250 Supplement Report was $218,100,000 and is shown in Table 1.

Table 1. June 2001 Final Task 250 Supplement Report Working Alternatives.

	Construction Cost[1] ($)	Project cost[2] ($)
Auburn		
Southwest Interceptor	$ 32,800,000	$ 67,100,000
26th Street Trunk	$ 2,100,000	$ 4,600,000
Stuck River Trunk	$ 9,200,000	$ 19,700,000
Auburn Subtotal	**$ 44,100,000**	**$ 91,400,000**
Kent		
Southwest Interceptor	$ 41,700,000	$ 85,100,000
James Trunk	$ 4,400,000	$ 9,500,000
Meeker Trunk	$ 2,600,000	$ 5,500,000
Garrison Creek Relief Trunk	$ 12,400,000	$ 26,600,000
Kent Subtotal	**$ 61,100,000**	**$ 126,700,000**
Total Estimated Cost	**$ 105,200,000**	**$ 218,100,000**

[1]Cost estimate based on CSI cost model 0.6.2 (2001 dollars)
[2]Cost estimate based on King County cost model (2001 dollars)

METHODOLOGY

Flow projections generated by King County for the June 2001 Final Task 250 Supplement Report were used to size interceptors for working alternatives presented. A 20-year storm event was used to predict flows through 2050. The flow projections included in the June 2001 Final Task 250 Supplement Report did not reflect the results of the recent County I/I study.

Pipe barrel capacity was estimated for each interceptor segment in the June 2001 Final Task 250 Supplement Report and no surcharging was allowed. The working alternatives in the June 2001 Final Task 250 Supplement Report involved constructing new, parallel interceptors to existing interceptors. The decade in which pipe barrel capacity was reached varied within each interceptor. However, portions of all interceptors reached capacity by 2010. Therefore, all working alternatives in the June 2001 Final Task 250 Supplement Report were required to be operational by 2010.

COST ESTIMATES

The cost model Tabula version 0.6.2 was used to estimate construction costs for working alternatives in the June 2001 Final Task 250 Supplement Report. The project cost model is based on historical project data was used to obtain project costs (construction, design, and planning) including a thirty percent contingency.

COST REDUCTION AND PHASING EVALUATION

The surcharge hydraulic evaluation described in this report investigates impacts to extent, timing, and budget of working alternatives presented in the June 2001 Final Task 250 Supplement Report by allowing limited surcharging during storm conditions. The extent of surcharging is shown graphically in Appendix A. The extent of surcharging is not fully known, although the revised working alternatives presented potentially eliminate overflow in the County's system. Revised working alternatives are shown in Figure 2 and are described in detail in the sections that follow.

METHODOLOGY

The Task 250A Supplement Report investigates the impacts of allowing surcharge in existing interceptors. The Task 250A Supplement Report sizes proposed interceptors to replace existing interceptors and convey the entire estimated flows through 2050. Constructing parallel interceptors includes continued use of the existing and new interceptors and has operational consideration beyond the scope of the Task 250A Supplement Report.

REVISED FLOW PROJECTIONS

Revised flow projections were provided by King County and reflect the results of I/I studies. Flow projections are estimated for years 2010, 2020, 2030, and 2050 and are included in Appendix B. Revised flow projections are lower than those used in the June 2001 Final Task 250 Supplement Report.

It is difficult to quantify the difference in flow projections between current projections because flow projection basins and system input locations have changed.

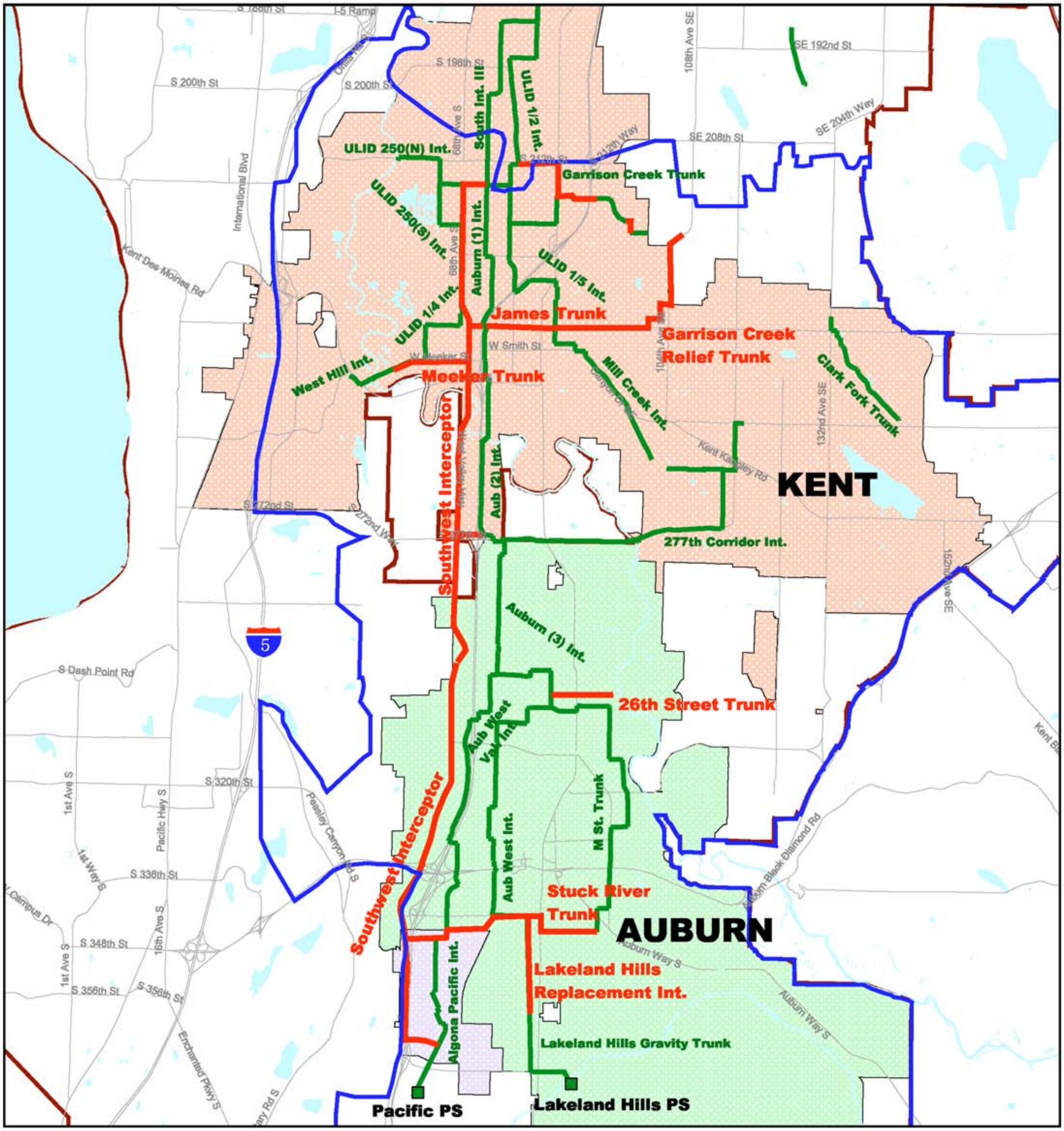

Figure 1: June 2001 Final Task 250 Supplement Report

Kent and Auburn Working Alternatives

Legend

- MC/GR Planning Boundary
- Working Alternatives
- KC Pump Stations
- MC/GR Sewerlines
- 2002 UGA Boundary

Incorporated Areas

- Algona
- Auburn
- Kent

King County

0.3 0 0.3 0.6 0.9 1.2 1.5 Miles

N

December 10, 2003

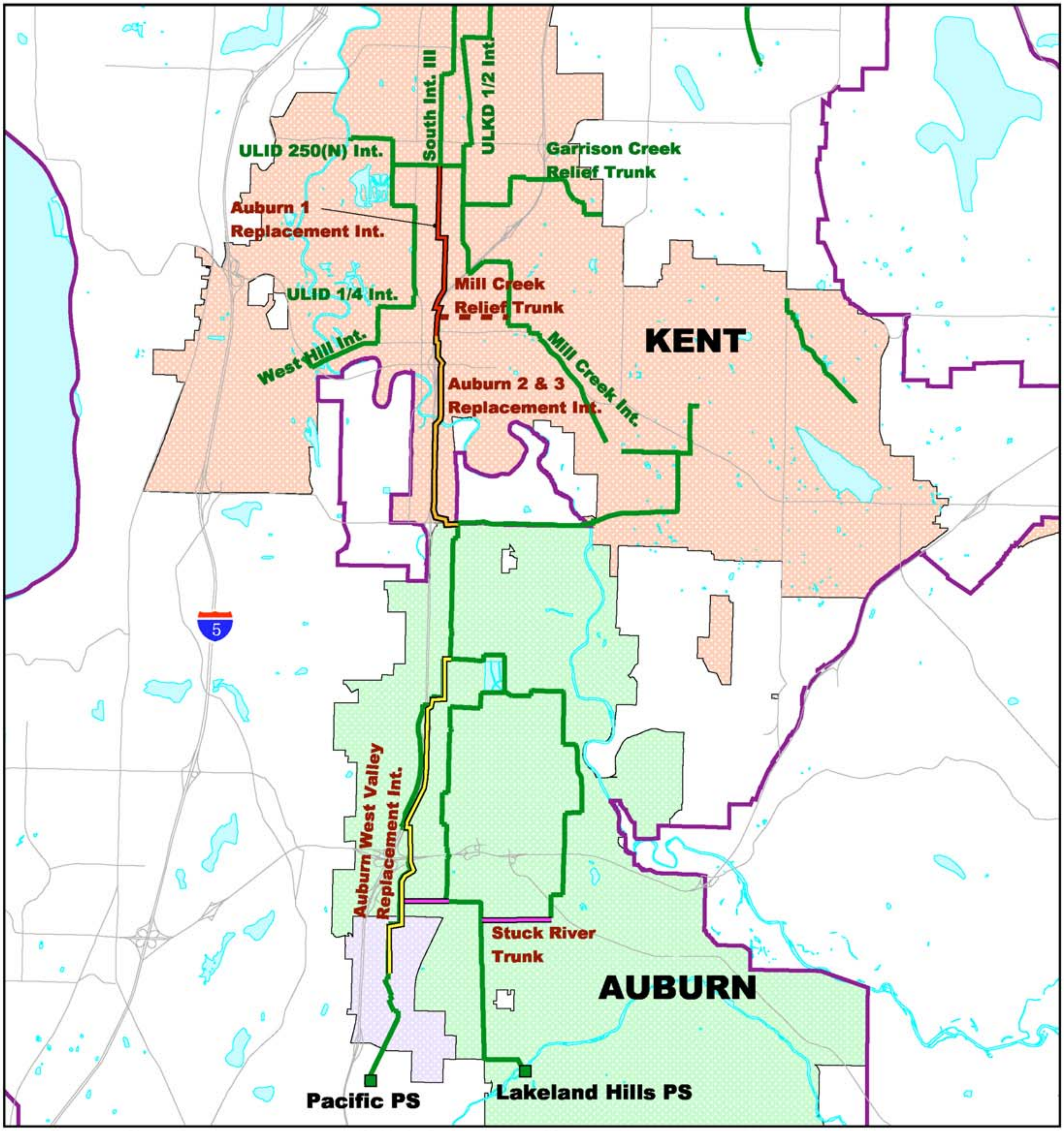

Figure 2 : December 2003 Task 250 A Supplement Report

Revised Working Alternatives Kent & Auburn

King County

0.3 0 0.3 0.6 0.9 1.2 1.5 Miles

N

December 10, 2003

File Name: PK \\dnrp1\projects\wtd\projects\csi project\mc_gr area\task 250\kent_auburn_250a.apr

Legend

Revised Working Alternatives

- 2020 - Auburn 1 Replacement Int.
- 2020 - Auburn 2 & 3 Replacement Int.
- 2010 - Auburn West Valley Replacment Int.
- 2010 - Mill Creek Relief Trunk
- 2010 - Stuck River Trunk
- KC Pump Stations
- MC/GR Sewerlines
- 2002 UGA Boundary

Incorporated Areas

- Algona
- Auburn
- Kent

HYDRAULIC MODEL

A hydraulic model was created to determine the hydraulic grade line (HGL) in the existing wastewater conveyance systems and is included as an attached, electronic, appendix. The hydraulic grade lines in the existing wastewater conveyance system for 2010, 2020, 2030, and 2050 flows are shown in Appendix A. More detailed hydraulic assumptions and methodology are included in Appendix C. The hydraulic model uses the existing wastewater conveyance systems configuration characteristics such as invert elevation, pipe diameter, and rim elevation to predict the performance of the existing wastewater conveyance system.

The hydraulic model does not allow surcharging at the connection points to the South III Interceptor and the ULID ½ Interceptor in the northern section of Kent. The extent and timing of the projects presented in this Task 250A Supplement Report may significantly change if surcharging is allowed or occurs at one or both of these locations. Analysis of the systems discharging to in the South III Interceptor and ULID ½ Interceptor is beyond the scope of this investigation.

The hydraulic model included in this investigation identifies the basic capacity limitations of the existing wastewater conveyance system. The hydraulic model also indicates the scope and timing of revised working alternatives. However, the model is adequate for a planning level investigation only. A more detailed and accurate hydraulic model should be developed for predesign to better define revised working alternatives.

KENT

The June 2001 Final Task 250 Supplement report presented several working alternatives in Kent. These working alternatives included portions of the Southwest Interceptor and all of the Garrison Creek Relief, James, and Meeker trunks. The construction and project cost estimates for revised working alternatives based on this Task 250A Supplement Report are presented in sections that follow.

REVISED WORKING ALTERNATIVES

Revised working alternatives in Kent are shown in Figure 3. The revised working alternatives are sized to convey the entire 2050, 20-year design flow. The interceptors included in revised working alternatives are sized to convey the entire estimated flow. Therefore, existing interceptors to be replaced are abandoned.

The revised working alternatives include the Mill Creek Relief Trunk and the Auburn 1, 2, and 3 Replacement Interceptors. The Garrison Creek Relief, James, and Meeker Trunks are likely not necessary with revised working alternative configurations.

PHASING

The construction phasing of revised working alternatives was investigated. Working alternatives presented in the June 2001 Final Task 250 Supplement Report are required by 2010 due to interceptor barrel capacity. Sections of interceptors reached capacity by 2010 within every existing interceptor.

Revised working alternatives can be phased and are required by 2010 and 2020.

2010

The Mill Creek Interceptor conveys flow to the ULID 1/5 Interceptor. Portions of the ULID 1/5 Interceptor currently experience surcharging during significant storm events. The hydraulic model used in this Task 250A Supplement Report also predicted capacity problems within sections of the ULID 1/5 Interceptor. The revised working alternatives include the Mill Creek Relief Trunk to eliminate surcharging in the ULID 1/5 Interceptor by conveying excess flow to the Auburn 1 Interceptor. The Mill Creek Relief Trunk is required by 2010.

2020

Portions of the Auburn 1 and 2 Interceptors experience capacity problems near decade 2020. As a result, Auburn 1 and 2 Replacement Interceptors are required by 2020. The Auburn 1 and 2 Replacement Interceptors were included as portions of the Southwest Interceptor in the June 2001 Final Task 250 Supplement report.

COST ESTIMATE

Construction and project cost estimates were produced for revised working alternatives. Construction cost estimates were produced for year 2003, were generated using Tabula, and are shown in Appendix D. Tabula is the current King County construction cost-estimating tool. Project costs were estimated from a King County model based on many previous County projects.

Project costs for revised working alternatives required by 2010 and 2020 are $4,760,000 and $70,945,000 respectively.

Table 2 includes construction and project costs for revised working alternatives in Kent. The total project cost for revised working alternatives in Kent is $75,705,000.

AUBURN

The June 2001 Final Task 250 Supplement Report presented working alternatives in Auburn. These revised working alternatives included portions of the Southwest Interceptor, all of the Stuck River Trunk, and the 26th Street Trunk. The construction and project costs for revised working alternatives are presented in later sections.

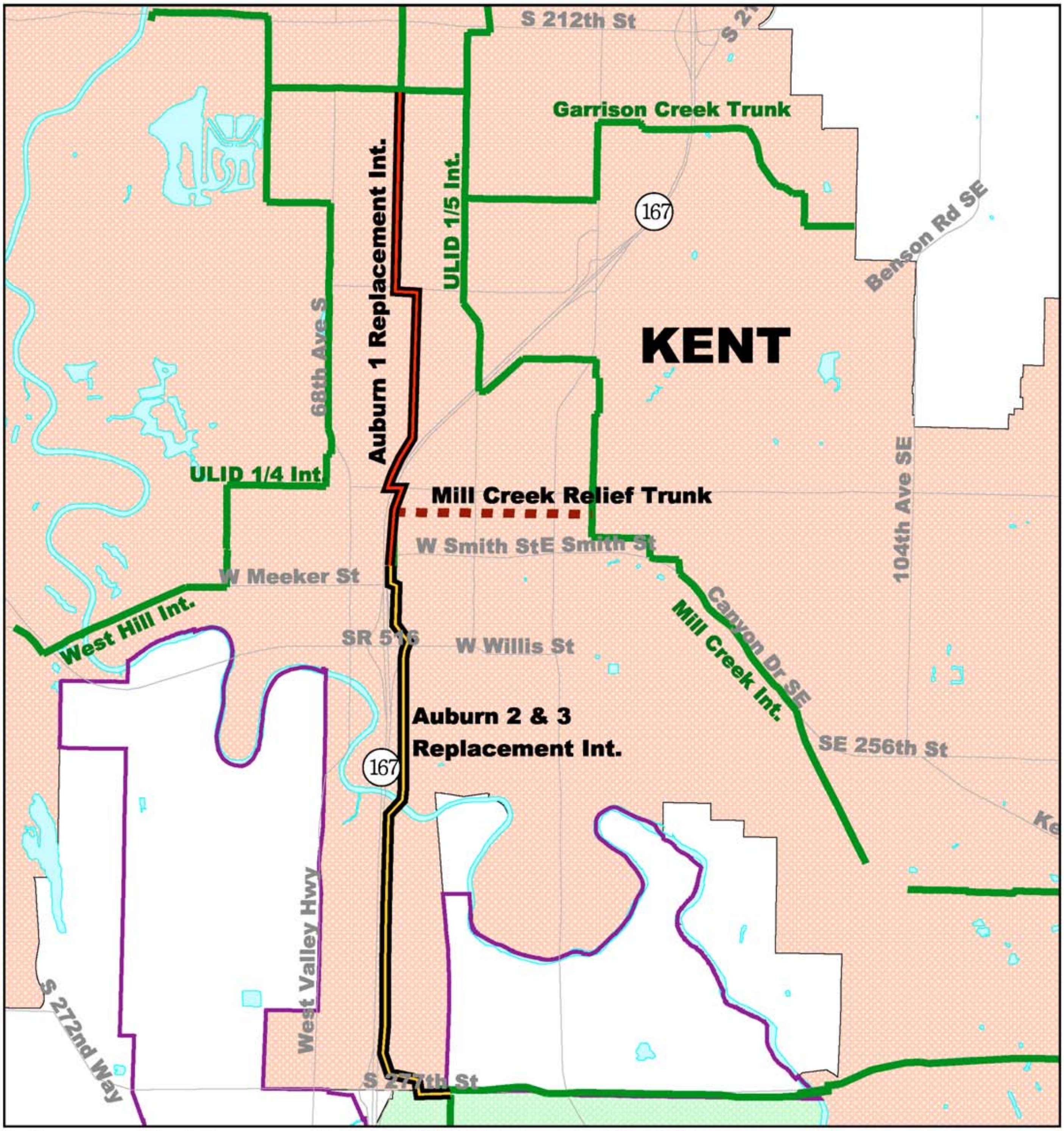

Figure 3: December 2003 Task 250A Supplement Report

Revised Working Alternative Kent

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King County

0.1 0 0.1 0.2 0.3 0.4 0.5 Miles

N

December 10, 2003

Legend

Revised Working Alternatives
- 2020 - Auburn 1 Replacment Int.
- 2020 - Auburn 2 & 3 Replacement Int.
- 2010 - Mill Creek Relief Trunk
- KC Pump Stations
- MC/GR Sewerlines
- 2002 UGA Boundary

Incorporated Areas
- Algona
- Auburn
- Kent

Table 2. Revised Working Alternatives – Kent.

	Decade	Construction Cost[1] ($)	Project cost[2] ($)
Mill Creek Relief Trunk	2010	$ 2,249,000	$ 4,760,000
Auburn 1 Replacement Interceptor	2020	$ 7,740,000	$ 16,382,000
Auburn 2 Replacement Interceptor	2020	$ 25,990,000	$ 54,563,000
Total		**$ 35,979,000**	**$ 75,705,000**

[1]Cost estimate based on CSI cost model 1.0 (2003 dollars)
[2]Cost estimate based on King County cost model (2003 dollars)

REVISED WORKING ALTERNATIVES

Revised working alternatives in Auburn are shown in Figure 4. The revised working alternatives are sized to convey the entire 2050, 20-year design flow. Therefore, existing interceptors to be replaced are abandoned.

The revised working alternatives include the Auburn West Valley Replacement Interceptor and the Stuck River Trunk. The Auburn West Valley Replacement Interceptor was a portion of the Southwest Interceptor in the June 2001 Final Task 250 Supplement Report. The portion of the Southwest Interceptor proposed in the June 2001 Final Task 250 Supplement Report that paralleled the portion of the existing Auburn 3 Interceptor located in Auburn is likely not necessary with revised working alternative configurations. The 26th Street Trunk is also likely not necessary with revised working alternative configurations.

PHASING

The phasing of revised working alternatives was investigated. Working alternatives presented in the June 2001 Final Task 250 Supplement Report are required by 2010 due to interceptor barrel capacity. Sections of interceptors reached capacity by 2010 within every existing interceptor.

All revised working alternatives in Auburn are required by 2010.

2010

The existing M Street Trunk currently experiences capacity problems during significant storm events. The Stuck River Trunk is proposed to convey excess flow to the Auburn West Valley Interceptor and eliminate capacity problems in the existing M Street Trunk.

The Stuck River Trunk also conveys excess flow from the Auburn West Interceptor and is a carry over from the June 2001 Final Task 250 Supplement Report. However, the size of the interceptor has changed due to revised system flow inputs from Soos Creek and updated flow projections.

The southern portion of the Auburn West Valley Replacement Interceptor receives flow from the Stuck River Trunk in addition to local basin inputs and the Algona Pacific Pump Station. The capacity of the Auburn West Valley Interceptor is reached by 2010 when flows from the Stuck River Truck are realized. As a result, all work in Auburn is required by 2010.

COST ESTIMATE

Construction and project cost estimates were produced for revised working alternatives in Auburn. Construction cost estimates were produced for year 2003 and were generated using Tabula. Tabula is the current King County construction cost-estimating tool. Project costs were estimated from a King County model based on many previous County projects.

Project costs for revised working alternatives are $34,539,000 are shown in Table 3.

Table 3. Revised Working Alternatives – Auburn.

	Decade	Construction Cost[1] ($)	Project cost[2] ($)
Stuck River Trunk	2010	$ 2,840,000	$ 6,011,000
Auburn West Valley Replacement Interceptor	2010	$ 13,640,000	$ 28,528,000
	Total	**$ 16,480,000**	**$ 34,539,000**

[1]Cost estimate based on CSI cost model 1.0 (2003 dollars)
[2]Cost estimate based on King County cost model (2003 dollars)

SCHEDULE

A basic schedule was generated to indicate general timing of key projects. Phase I projects are those in Kent and Auburn that are required by 2010. They include the Mill Creek Relief Trunk, Auburn West Valley Replacement Interceptor, and the Stuck River Trunk.

PHASE I

- 2004 Consultant Selection
- 2006 Pre-Design
- 2007 Final Design
- 2008 Permitting
- 2010 Construction.

Phase II includes projects in Kent required by 2020 and include the Auburn 1, 2, and 3, Interceptors.

PHASE II

- Begins 2011±.

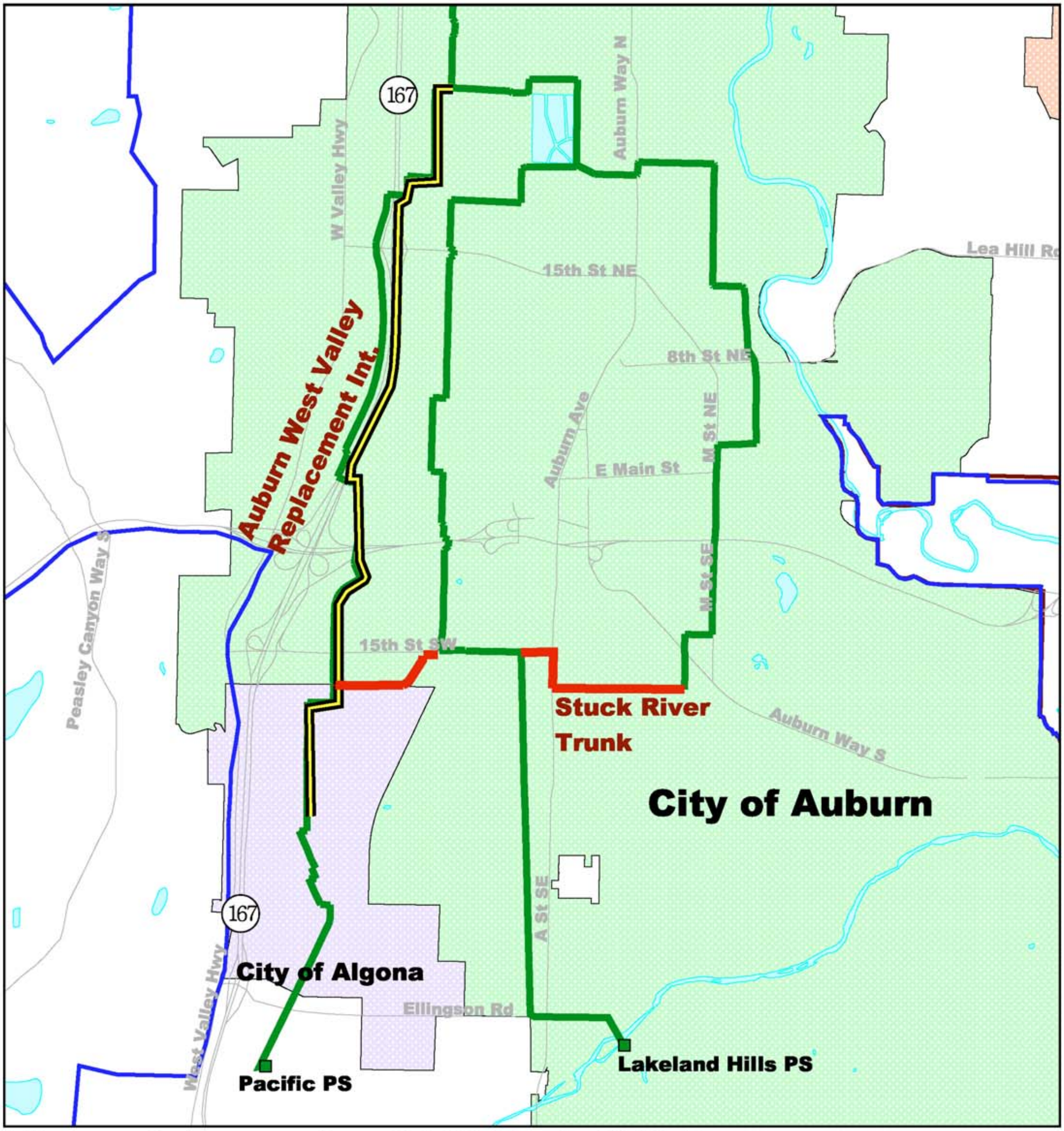

Figure 4: December 2003 Task 250 A Supplement Report

Revised Working Alternatives Auburn

King County

0.1 0 0.1 0.2 0.3 0.4 0.5 Miles

N

December 11, 2003

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Legend
- MC/GR Planning Basin
- KC Pump Stations
- 2010 - Stuck River Trunk
- 2010 - Auburn West Valley Int.
- MC/GR Sewerlines
- 2002 UGA Boundary
- County Boundary

Incorporated Areas
- Algona
- Auburn
- Kent

SUMMARY AND CONCLUSION

The revised working alternatives presented in this report can reduce the extent of working alternatives presented in the June 2001 Final Task 250 Supplement Report. Revised working alternatives can also be phased. Phasing revised working alternatives reduces the budget required in the next decade. The total project cost for revised working alternatives in Kent and Auburn is $110,244,000. The total project cost for working alternatives presented in the June 2001 Final Task 250 Supplement Report was $218,100,000. Allowing surcharging can potentially reduce project costs by approximately $107,856,000.

The revised working alternative pipelines are sized to carry the 2050, 20-year storm. However, surcharging occurs in some existing pipelines in the County's Kent and Auburn system with revised working alternatives pipeline in place. Although the surcharge level does not overtop most manholes in the current model at year 2050, a more thorough investigation needs to be performed to better determine surcharge impacts to County and local systems.

The following interceptor needs to be re-evaluated during pre-design for surcharge performance:

- West Hill Interceptor.

Some overflow is indicated in hydraulic profiles at year 2050 in the interceptor listed above. It is unclear whether these interceptors will actually overtop at year 2050. The model used in this report is not accurate enough to determine the exact extent of overtopping with complete certainty. As a result, locations where an overtop condition may occur should be further investigated to better determine their ability to convey future flows.

It is beyond the scope of this Task 250A Supplement Report to discuss all issues that should be addressed or revisited during pre-design. At a minimum, impacts of surcharging on local wastewater systems needs to be thoroughly investigated during predesign. An accurate and detailed hydraulic analysis and system model should be developed to better determine final working alternatives. Also, a more thorough hydraulic analysis of the system might include backwater calculations beginning at the inlet works of the South Treatment Plant.

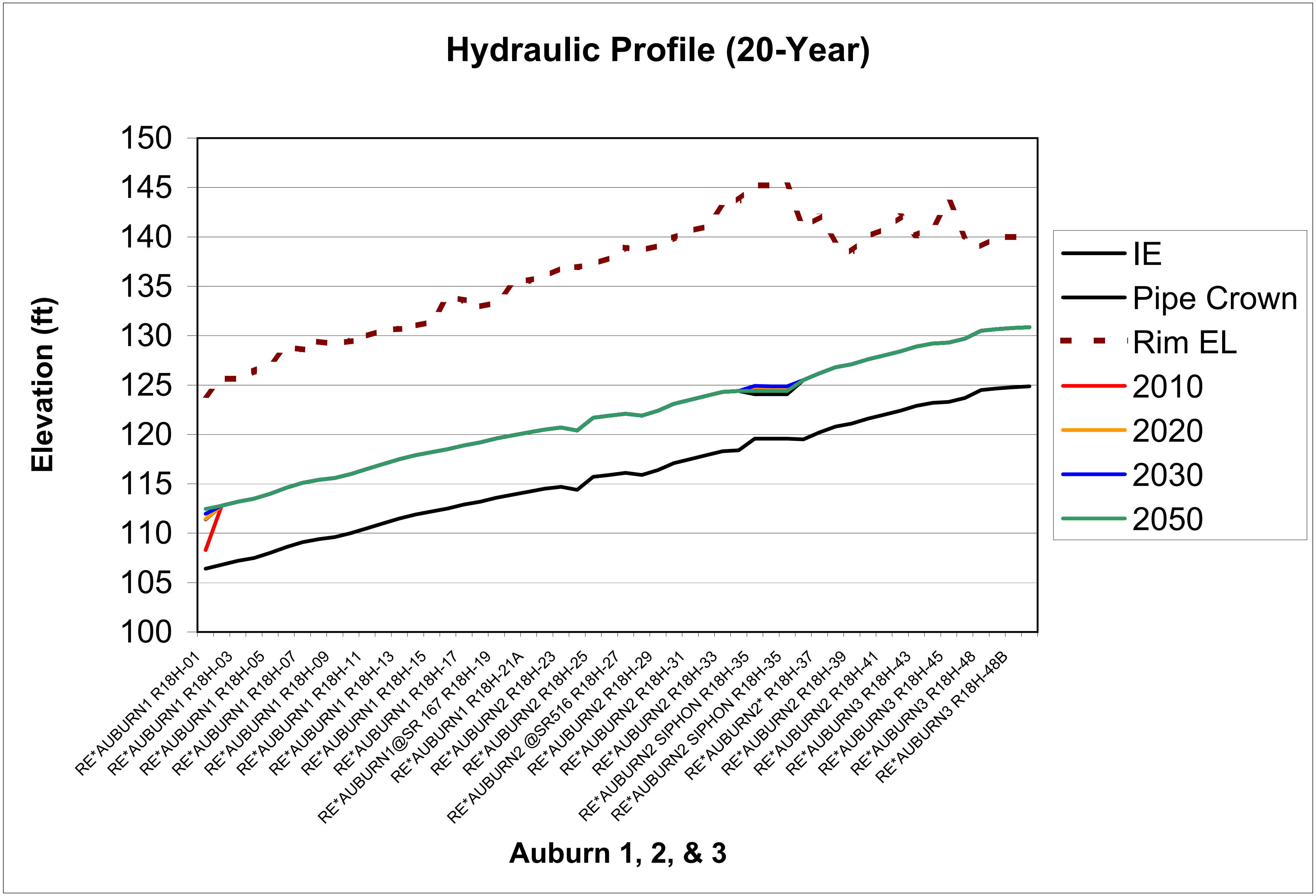
Surcharging at unexpected locations and levels can present serious public health problems. An investigation should be conducted to determine potential for human exposure to pathogens by allowing system surcharging.

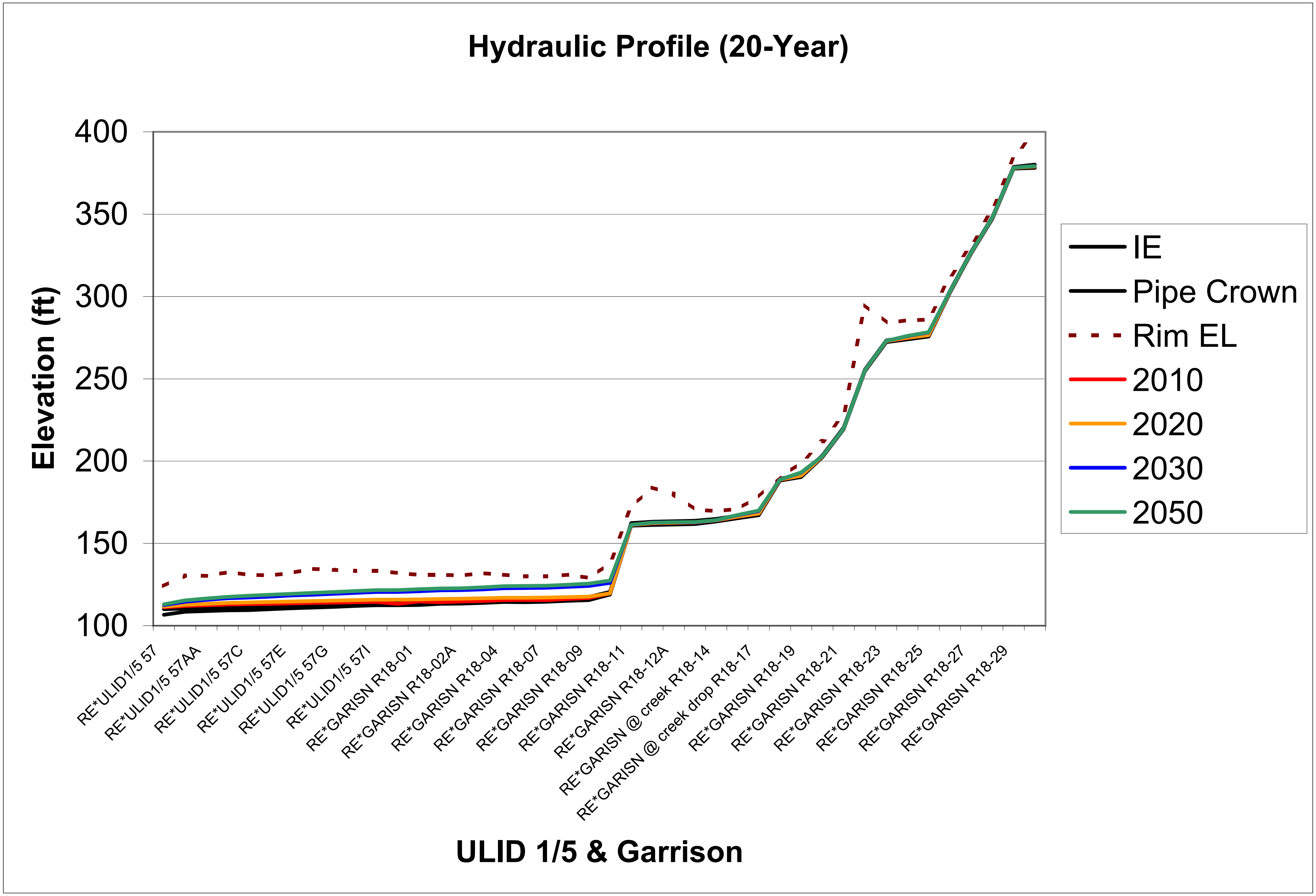
Project costs savings of $107,856,000 may or may not be attainable. A more accurate savings potential will be obtained after revised working alternative pre-design. However, a potential for significant savings does exist by allowing limited amounts of surcharging during storm events.

APPENDIX A

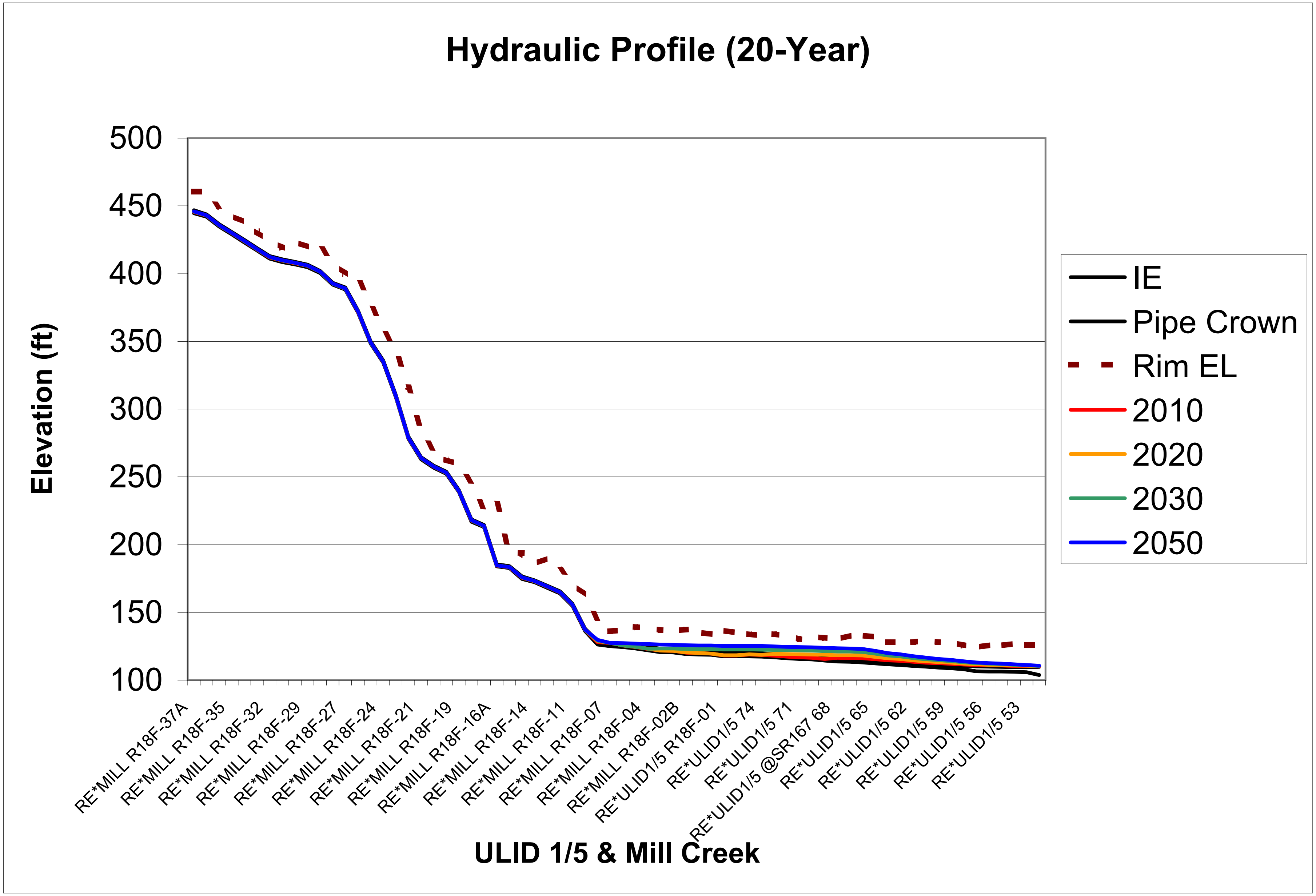
Hydraulic Profiles With All 2010 and 2020 Revised Working Alternatives

Kent


Hydraulic Profile (20-Year)
Elevation (ft)
150
145
140
135
130
125
120
115
110
105
100
IE
Pipe Crown
Rim EL
2010
2020
2030
2050
RE*AUBURN1 R18H-01
RE*AUBURN1 R18H-03
RE*AUBURN1 R18H-05
RE*AUBURN1 R18H-07
RE*AUBURN1 R18H-09
RE*AUBURN1 R18H-11
RE*AUBURN1 R18H-13
RE*AUBURN1 R18H-15
RE*AUBURN1 R18H-17
RE*AUBURN1@SR 167 R18H-19
RE*AUBURN1 R18H-21A
RE*AUBURN2 R18H-23
RE*AUBURN2 R18H-25
RE*AUBURN2 @SR516 R18H-27
RE*AUBURN2 R18H-29
RE*AUBURN2 R18H-31
RE*AUBURN2 R18H-33
RE*AUBURN2 SIPHON R18H-35
RE*AUBURN2 SIPHON R18H-35
RE*AUBURN2* R18H-37
RE*AUBURN2 R18H-39
RE*AUBURN2 R18H-41
RE*AUBURN3 R18H-43
RE*AUBURN3 R18H-45
RE*AUBURN3 R18H-48
RE*AUBURN3 R18H-48B
Auburn 1, 2, & 3



Hydraulic Profile (20-Year)
Elevation (ft)
400
350
300
250
200
150
100
RE*ULID1/5 57
RE*ULID1/5 57AA
RE*ULID1/5 57C
RE*ULID1/5 57E
RE*ULID1/5 57G
RE*ULID1/5 57I
RE*GARISN R18-01
RE*GARISN R18-02A
RE*GARISN R18-04
RE*GARISN R18-07
RE*GARISN R18-09
RE*GARISN R18-11
RE*GARISN R18-12A
RE*GARISN @ creek R18-14
RE*GARISN @ creek drop R18-17
RE*GARISN R18-19
RE*GARISN R18-21
RE*GARISN R18-23
RE*GARISN R18-25
RE*GARISN R18-27
RE*GARISN R18-29
ULID 1/5 & Garrison
IE
Pipe Crown
Rim EL
2010
2020
2030
2050



Hydraulic Profile (20-Year)
Elevation (ft)
500
450
400
350
300
250
200
150
100
ULID 1/5 & Mill Creek
RE*MILL R18F-37A
RE*MILL R18F-35
RE*MILL R18F-32
RE*MILL R18F-29
RE*MILL R18F-27
RE*MILL R18F-24
RE*MILL R18F-21
RE*MILL R18F-19
RE*MILL R18F-16A
RE*MILL R18F-14
RE*MILL R18F-11
RE*MILL R18F-07
RE*MILL R18F-04
RE*MILL R18F-02B
RE*ULID1/5 R18F-01
RE*ULID1/5 74
RE*ULID1/5 71
RE*ULID1/5 @SR167 68
RE*ULID1/5 65
RE*ULID1/5 62
RE*ULID1/5 59
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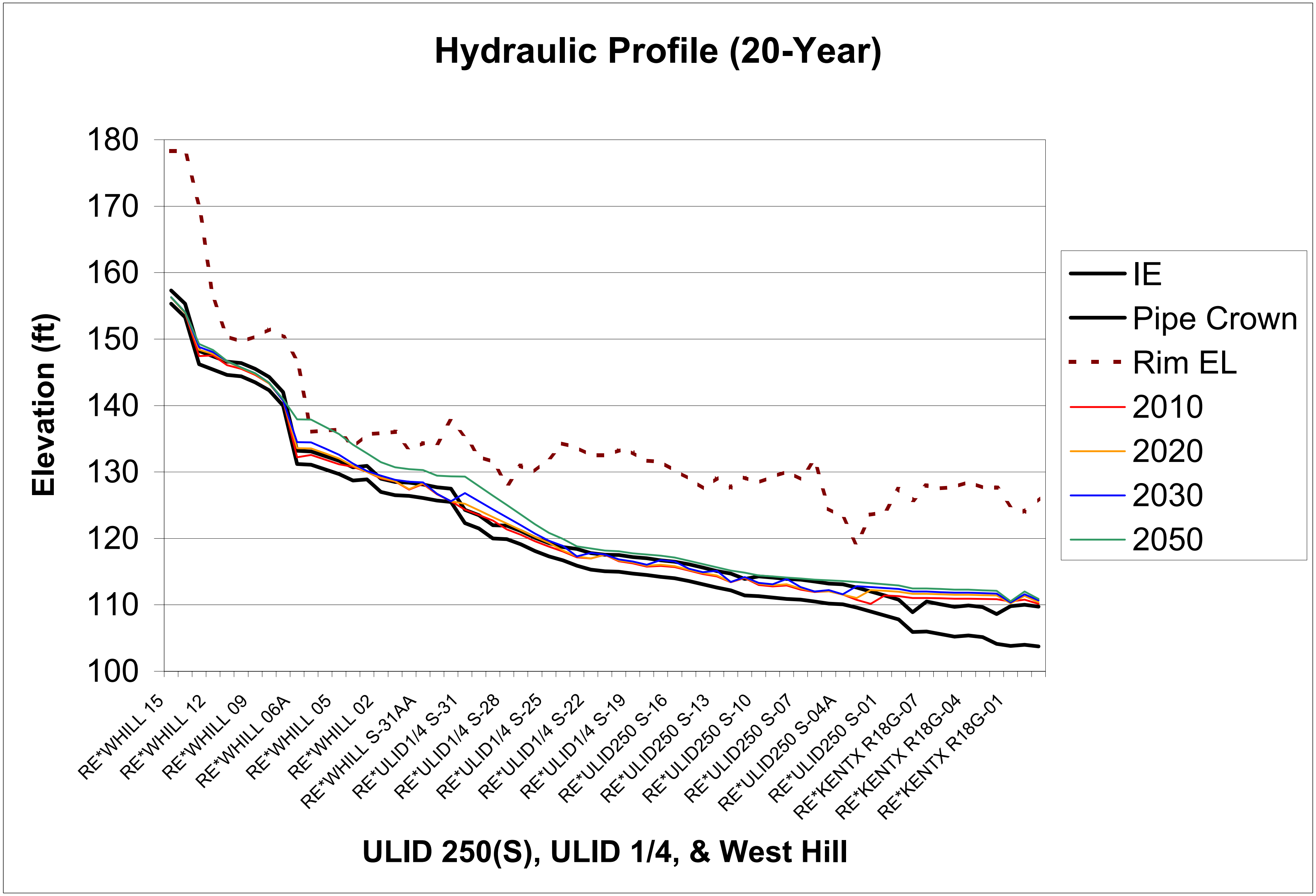
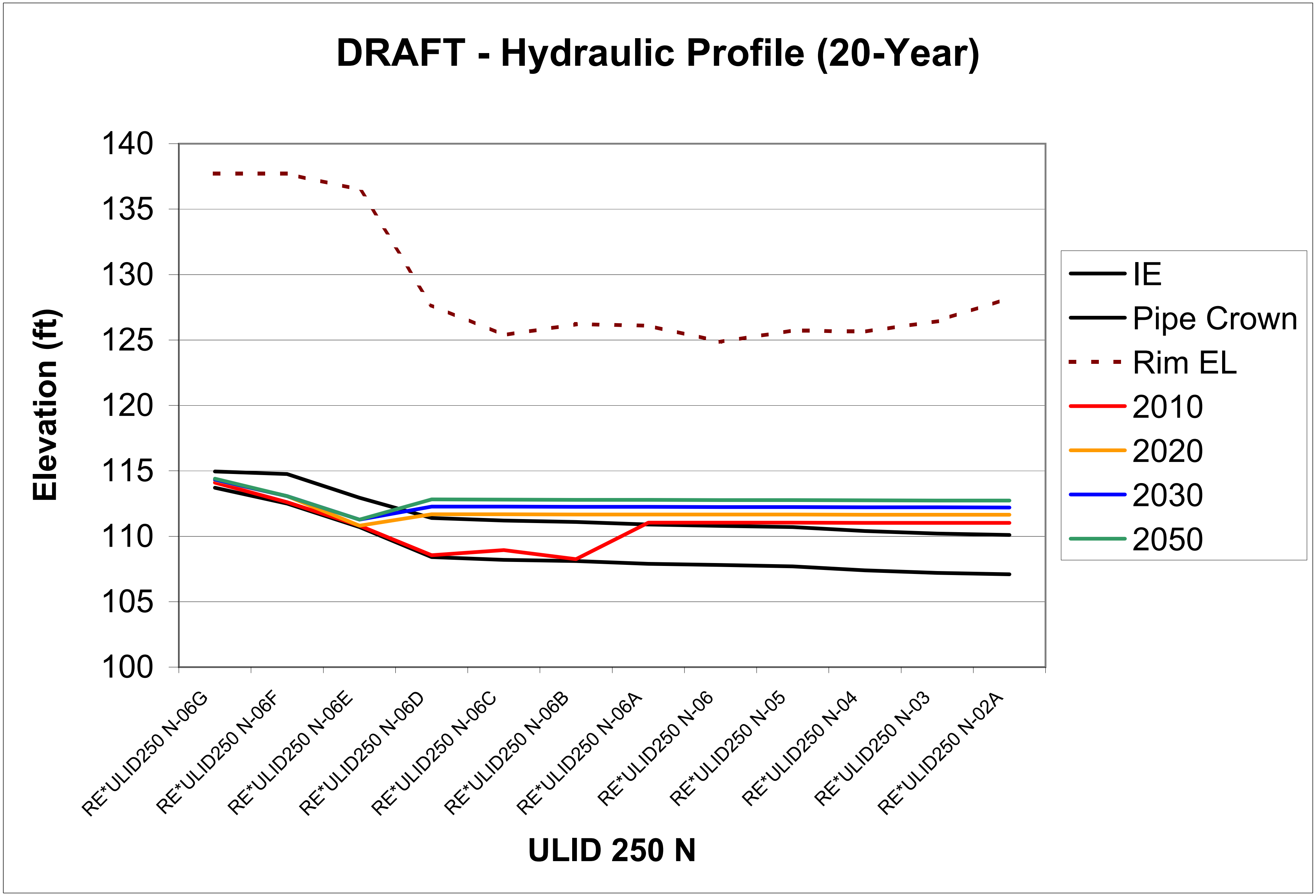
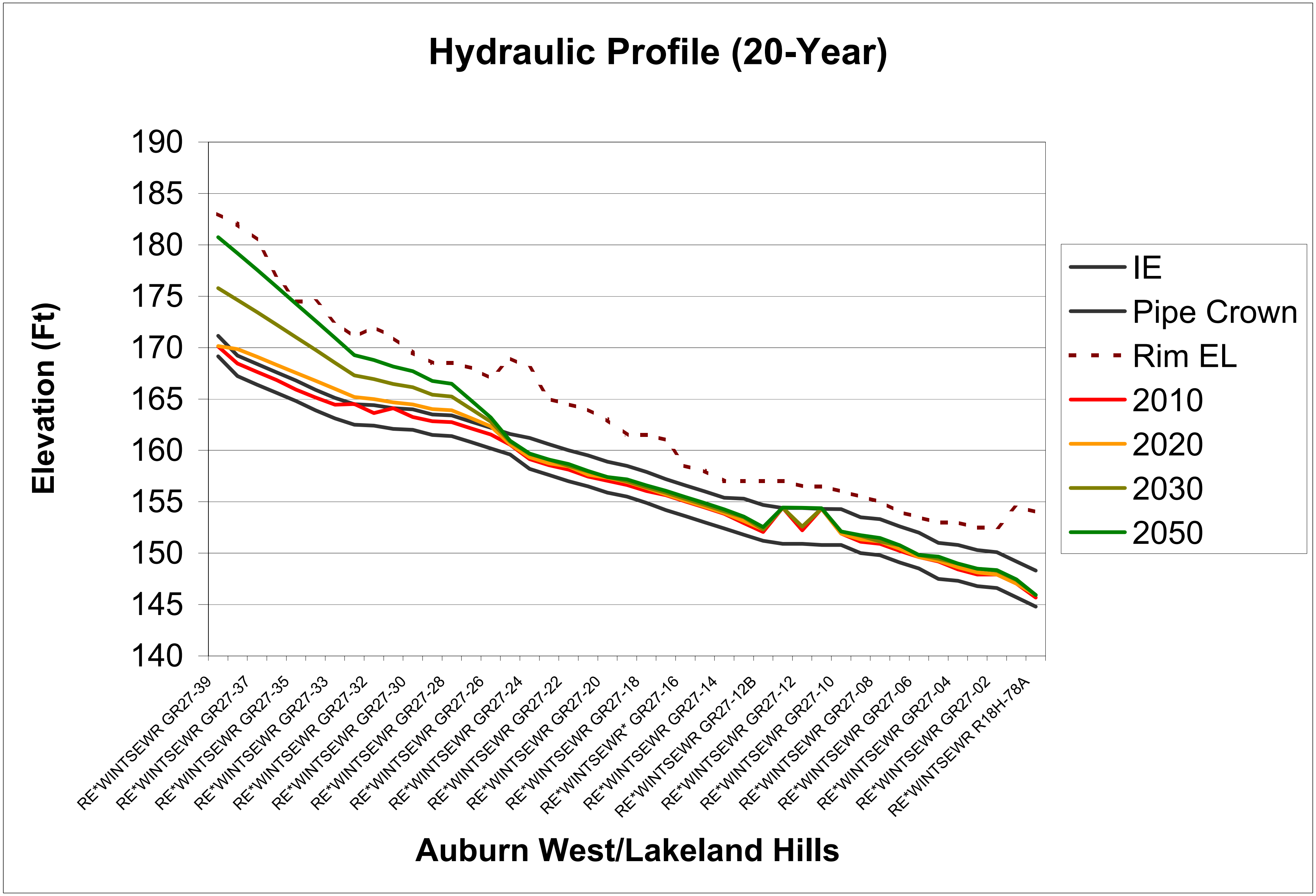
IE
Pipe Crown
Rim EL
2010
2020
2030
2050

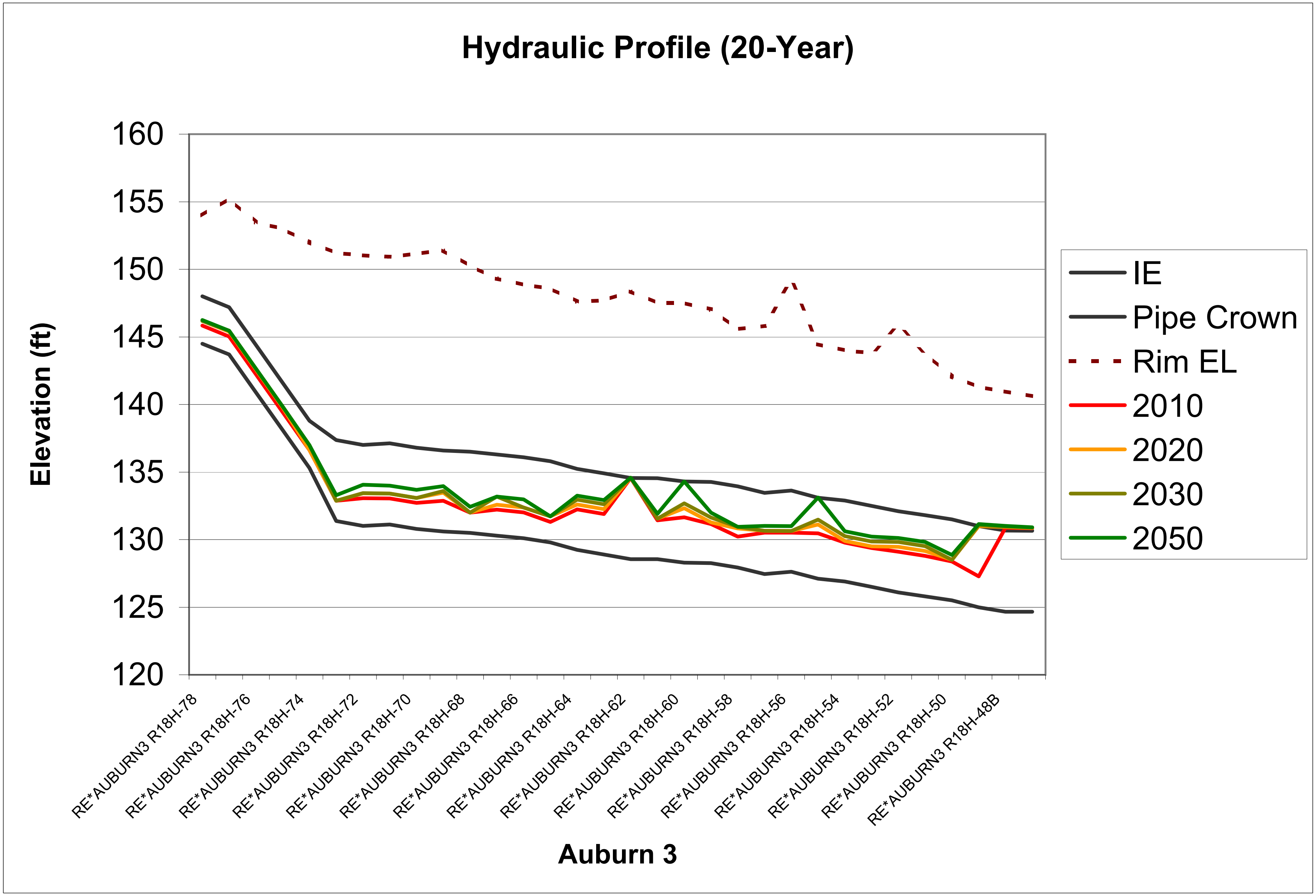


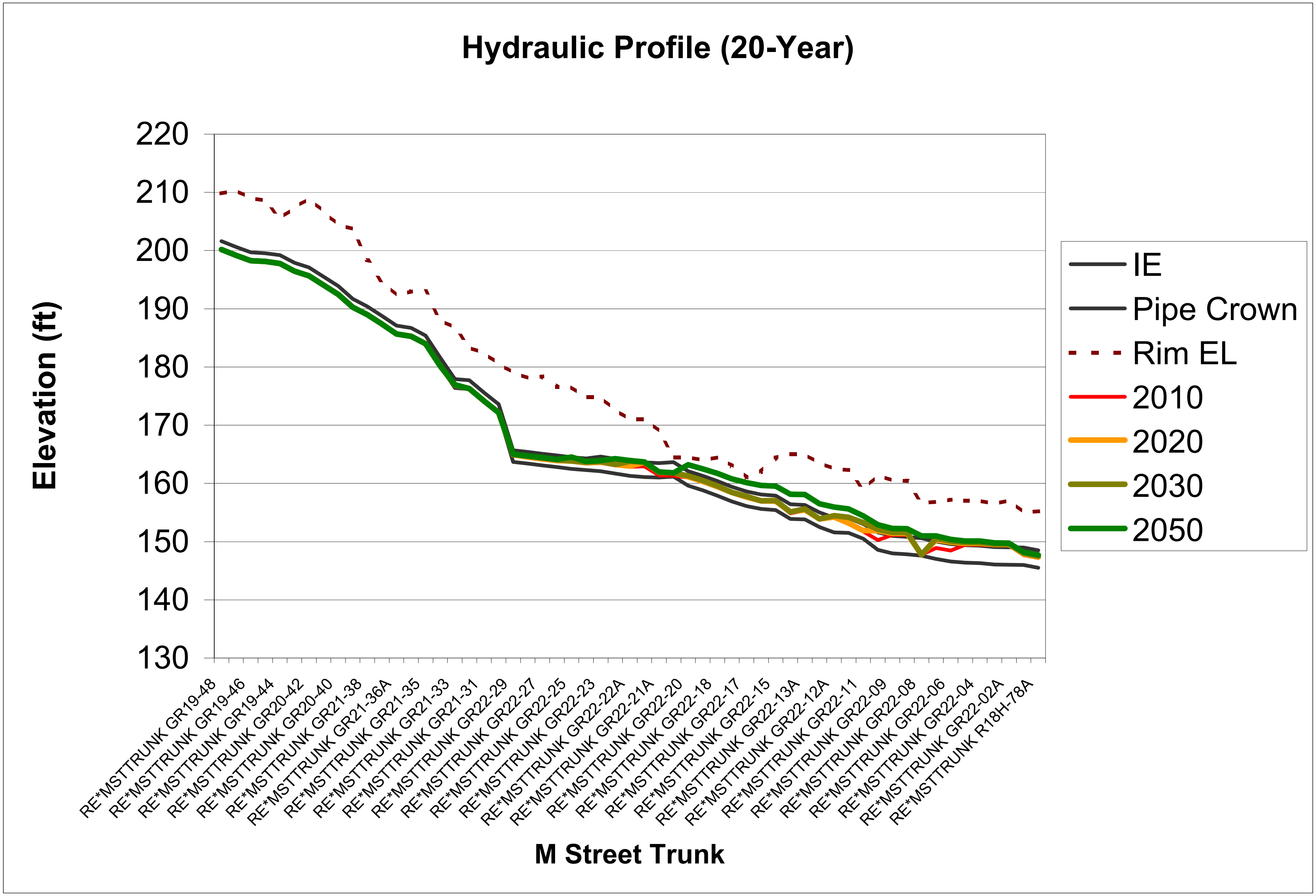
Hydraulic Profile (20-Year)
Elevation (ft)
180
170
160
150
140
130
120
110
100
RE*WHILL 15
RE*WHILL 12
RE*WHILL 09
RE*WHILL 06A
RE*WHILL 05
RE*WHILL 02
RE*WHILL S-31AA
RE*ULID1/4 S-31
RE*ULID1/4 S-28
RE*ULID1/4 S-25
RE*ULID1/4 S-22
RE*ULID1/4 S-19
RE*ULID250 S-16
RE*ULID250 S-13
RE*ULID250 S-10
RE*ULID250 S-07
RE*ULID250 S-04A
RE*ULID250 S-01
RE*KENTX R18G-07
RE*KENTX R18G-04
RE*KENTX R18G-01
ULID 250(S), ULID 1/4, & West Hill
IE
Pipe Crown
Rim EL
2010
2020
2030
2050

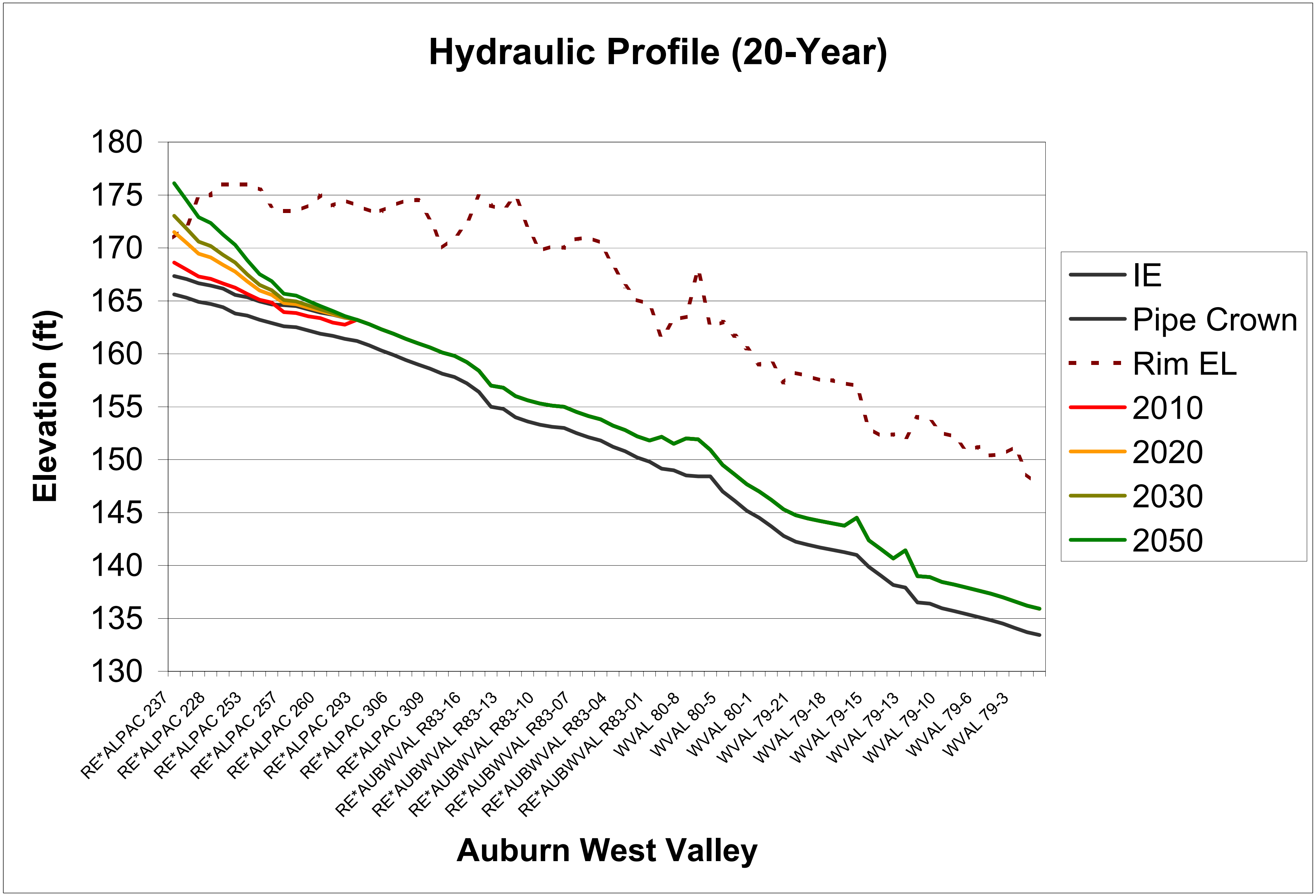

DRAFT - Hydraulic Profile (20-Year)
Elevation (ft)
140
135
130
125
120
115
110
105
100
IE
Pipe Crown
Rim EL
2010
2020
2030
2050
RE*ULID250 N-06G
RE*ULID250 N-06F
RE*ULID250 N-06E
RE*ULID250 N-06D
RE*ULID250 N-06C
RE*ULID250 N-06B
RE*ULID250 N-06A
RE*ULID250 N-06
RE*ULID250 N-05
RE*ULID250 N-04
RE*ULID250 N-03
RE*ULID250 N-02A
ULID 250 N

Auburn


Hydraulic Profile (20-Year)
Elevation (Ft)
190
185
180
175
170
165
160
155
150
145
140
RE*WINTSEWR GR27-39
RE*WINTSEWR GR27-37
RE*WINTSEWR GR27-35
RE*WINTSEWR GR27-33
RE*WINTSEWR GR27-32
RE*WINTSEWR GR27-30
RE*WINTSEWR GR27-28
RE*WINTSEWR GR27-26
RE*WINTSEWR GR27-24
RE*WINTSEWR GR27-22
RE*WINTSEWR GR27-20
RE*WINTSEWR GR27-18
RE*WINTSEWR* GR27-16
RE*WINTSEWR GR27-14
RE*WINTSEWR GR27-12B
RE*WINTSEWR GR27-12
RE*WINTSEWR GR27-10
RE*WINTSEWR GR27-08
RE*WINTSEWR GR27-06
RE*WINTSEWR GR27-04
RE*WINTSEWR GR27-02
RE*WINTSEWR R18H-78A
Auburn West/Lakeland Hills
IE
Pipe Crown
Rim EL
2010
2020
2030
2050


Hydraulic Profile (20-Year)
Elevation (ft)
160
155
150
145
140
135
130
125
120
IE
Pipe Crown
Rim EL
2010
2020
2030
2050
RE*AUBURN3 R18H-78
RE*AUBURN3 R18H-76
RE*AUBURN3 R18H-74
RE*AUBURN3 R18H-72
RE*AUBURN3 R18H-70
RE*AUBURN3 R18H-68
RE*AUBURN3 R18H-66
RE*AUBURN3 R18H-64
RE*AUBURN3 R18H-62
RE*AUBURN3 R18H-60
RE*AUBURN3 R18H-58
RE*AUBURN3 R18H-56
RE*AUBURN3 R18H-54
RE*AUBURN3 R18H-52
RE*AUBURN3 R18H-50
RE*AUBURN3 R18H-48B
Auburn 3


Hydraulic Profile (20-Year)
Elevation (ft)
220
210
200
190
180
170
160
150
140
130
IE
Pipe Crown
Rim EL
2010
2020
2030
2050
RE*MSTTRUNK GR19-48
RE*MSTTRUNK GR19-46
RE*MSTTRUNK GR19-44
RE*MSTTRUNK GR20-42
RE*MSTTRUNK GR20-40
RE*MSTTRUNK GR21-38
RE*MSTTRUNK GR21-36A
RE*MSTTRUNK GR21-35
RE*MSTTRUNK GR21-33
RE*MSTTRUNK GR21-31
RE*MSTTRUNK GR22-29
RE*MSTTRUNK GR22-27
RE*MSTTRUNK GR22-25
RE*MSTTRUNK GR22-23
RE*MSTTRUNK GR22-22A
RE*MSTTRUNK GR22-21A
RE*MSTTRUNK GR22-20
RE*MSTTRUNK GR22-18
RE*MSTTRUNK GR22-17
RE*MSTTRUNK GR22-15
RE*MSTTRUNK GR22-13A
RE*MSTTRUNK GR22-12A
RE*MSTTRUNK GR22-11
RE*MSTTRUNK GR22-09
RE*MSTTRUNK GR22-08
RE*MSTTRUNK GR22-06
RE*MSTTRUNK GR22-04
RE*MSTTRUNK GR22-02A
RE*MSTTRUNK R18H-78A
M Street Trunk



Hydraulic Profile (20-Year)
Elevation (ft)
180
175
170
165
160
155
150
145
140
135
130
RE*ALPAC 237
RE*ALPAC 228
RE*ALPAC 253
RE*ALPAC 257
RE*ALPAC 260
RE*ALPAC 293
RE*ALPAC 306
RE*ALPAC 309
RE*AUBWVAL R83-16
RE*AUBWVAL R83-13
RE*AUBWVAL R83-10
RE*AUBWVAL R83-07
RE*AUBWVAL R83-04
RE*AUBWVAL R83-01
WVAL 80-8
WVAL 80-5
WVAL 80-1
WVAL 79-21
WVAL 79-18
WVAL 79-15
WVAL 79-13
WVAL 79-10
WVAL 79-6
WVAL 79-3
Auburn West Valley
IE
Pipe Crown
Rim EL
2010
2020
2030
2050

APPENDIX B

Flow Projections from King County

Memo

To: Calvin Locke

From: Zhong Ji

CC: Bob Peterson, Ed Cox

Date: 8/18/2003

Re: Soos-Kent Area Flow Projection **(Preliminary)**

Hydrological models for basins in Kent-Soos area are calibrated using the metered data collected for the I/I project. Using the calibrated models for the basins and the long-term rainfall record, the flow projections are drafted for locations shown in the following map.

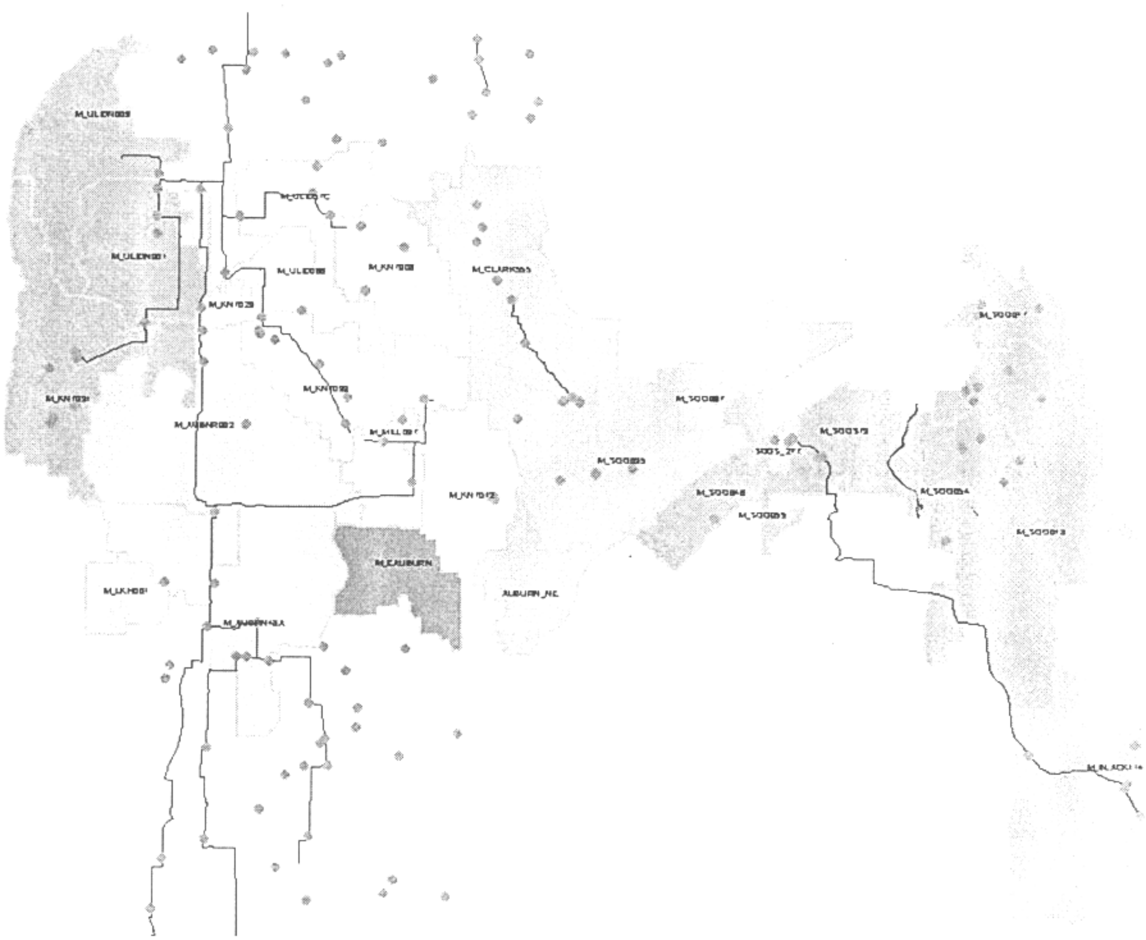


Figure 1. Map showing basins and manholes where flow projections are preliminarily made.

Flow projections at locations in Black Diamond, Soos Creek, and Kent Area (Tables show flow contribution between upstream inflow location and the listed location only from the color coded areas in Figure 1)

Black Diamond Trunk inflow(s)
RE*BLKDIA.114

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	1.23	1.53	
2010	2.20	2.74	
2020	3.30	4.01	
2030	4.29	5.27	
2040	4.56	5.79	
2050	4.84	5.82	6.98
From basins	M_BLACK114		

Black Diamond Trunk downstream inflow(s)
RE*BLKDIA.001

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	4.84	5.57	
2010	6.09	6.99	
2020	7.14	8.36	
2030	8.27	9.69	
2040	8.72	10.20	
2050	9.03	10.52	12.62
From basins	M_SOO017,M_SOO054,M_SOO073,M_SOO055,M_SOO046		

Kent Cascade Interceptor inflow(s)
RE*KENTCASC.94-01

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	7.14	8.61	
2010	9.49	11.34	
2020	11.40	13.69	
2030	13.46	16.13	
2040	14.34	17.07	
2050	14.93	17.60	21.12
From basins	M_SOO035, M_SOO037, M_EAUBURN, M_CLARK555		

South 277 Interceptor inflow(s)
RE*S277TH.R98-28

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	0.00	0.00	
2010	0.47	0.55	
2020	0.80	1.00	
2030	1.22	1.45	
2040	1.31	1.54	
2050	1.40	1.63	1.96
From basins	AUBURN_NE		

Mill Creek Interceptor inflow(s)
RE*MILL.R18F-37

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	3.90	4.74	
2010	5.01	6.05	
2020	6.03	7.18	
2030	7.20	8.58	
2040	7.85	9.24	
2050	8.17	9.66	11.59
From basins	M_KNT012, M_MILL037		

Mill Creek Interceptor inflow(s)
RE*MILL.R18F-07

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	4.95	5.89	
2010	5.46	6.45	
2020	5.97	7.08	
2030	6.49	7.66	
2040	6.91	8.16	
2050	7.05	8.30	9.96
From basins	M_KNT033		

Mill Creek Interceptor inflow(s)
RE*ULID1/5.66

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	2.39	2.89	
2010	2.71	3.30	
2020	3.07	3.70	
2030	3.44	4.09	
2040	3.66	4.37	
2050	3.73	4.45	5.34
From basins	M_ULID066		

Garrison Creek Interceptor Inflow(s)
RE*GARISN.R18-23

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	3.58	3.06	
2010	4.09	3.52	
2020	4.57	3.92	
2030	4.42	5.15	
2040	4.66	5.50	
2050	4.79	5.63	6.76
From basins	M_KNT008		

ULID 1/5 Inflow
RE*ULID 1/5.57C

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	2.63	2.25	
2010	3.02	2.59	
2020	3.45	2.93	
2030	3.26	3.85	
2040	3.48	4.08	
2050	3.54	4.22	5.06
From basins	M_ULID 57C		

ULID 1/4 Inflow
RE*ULID 1/4.S-30

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	4.33	5.46	
2010	4.93	6.19	
2020	5.54	6.83	
2030	6.13	7.56	
2040	6.39	8.10	
2050	6.63	8.20	9.85
From basins	M_KNT031		

ULID 250 Inflow
RE*ULID250.N-03

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	0.58	0.63	
2010	0.98	1.11	
2020	1.39	1.59	
2030	1.76	2.14	
2040	1.86	2.24	
2050	1.96	2.34	2.81
From basins	M_ULIDN003		

ULID
RE*ULID250.N-01

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	2.71	3.26	
2010	2.92	3.51	
2020	3.19	3.90	
2030	3.43	4.17	
2040	3.56	4.30	
2050	3.69	4.43	5.32
From basins	M_ULID N001		

Auburn Interceptor
RE*AUBURN3.R18H-58

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	0.62	0.75	
2010	0.83	1.02	
2020	1.05	1.24	
2030	1.23	1.45	
2040	1.29	1.52	
2050	1.30	1.58	1.89
From basins	M_LKH001		

Auburn Interceptor Inflow
RE*AUBURN3.R18H-48A

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	5.88	7.71	
2010	6.64	8.63	
2020	7.42	9.75	
2030	8.32	10.94	
2040	8.91	11.53	
2050	9.00	11.62	13.94
From basins	M_AUBRN48A		

Auburn Interceptor Inflow
RE*AUBURN1.R18H-19

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	2.12	2.87	
2010	2.28	3.09	
2020	2.46	3.32	
2030	2.62	3.53	
2040	2.78	3.75	
2050	2.81	3.77	4.53
From basins	M_KNT029		

Auburn Interceptor Inflow
RE*AUBURN1.R18H-02

	5yr Peak (mgd)	20yr Peak (mgd)	20yr Peak (mgd) x1.2
2000	3.11	3.69	
2010	3.65	4.37	
2020	4.23	4.99	
2030	4.76	5.65	
2040	5.15	6.04	
2050	5.27	6.29	7.55
From basins	M_AUBNR002		

The above table is generated with the following assumptions:

- Peak I/I for existing conditions is determined according to statistical analysis of MOUSE model results using long-term rainfall data.
- Existing sewers will be degraded in terms of peak I/I at the rate of 7% of the 2000 I/I rate per decade, up to 2040 (28% total degradation).
- New sewers will have a 5 year peak I/I of 1200 gpad and a 20 year peak I/I of 1500 gpad
- New sewers degrade at 7% per decade, starting from the end of the decade of their installation.
- All sewerable area is assumed to be sewered in 2020
- Base sewage rate is determined according to TAZ population projection with flow factors of 65 gallons per resident per day, 33 gallons per commercial employee per day, and 55 gallons per industrial employee per day.
- A peaking factor of 1.9 is imposed on the base sewage and added to peak I/I value to obtain peak flow estimates.

APPENDIX C

Surcharge Hydraulic Evaluation Methodology

APPENDIX C
CSI MILL CREEK/GREEN RIVER SPA
KENT & AUBURN
TASK 250A SUPPLEMENT REPORT

A spreadsheet was created to model pipeline hydraulics for the King County regional pipeline wastewater conveyance systems located in Kent and Auburn. King County requested that surcharging be investigated within the regional system in order to possibly postpone capitol improvement projects presented in the Final Task 240 Report June 2001. An Excel spreadsheet model was created to estimate the hydraulic grade line (HGL) in the pipeline during 2010, 2020, 2030, and 2050 predicted flows supplied by the County.

The following discussion presents the methodology, hydraulic principals and calculations used to predict the HGL in the regional pipelines. A step approach is used to predict the water surface elevation or HGL. Two primary flow conditions govern in a pipeline. The first condition occurs when the flow is governed by gravity or the pipeline is not under pressure. The second condition occurs when the pipeline is under pressure and is considered submerged.

The submerged condition is tested first in the downstream portion of the pipeline. If a submerged condition exists, an equation is applied to predict the water surface elevation in the upstream section of the pipeline. A subtest is also performed within the original test to allow for the pipeline to transition form submerged to gravity flow within the section of pipeline.

The gravity condition is tested next. Gravity or submerged equations are applied if the pipeline continues to operate in gravity mode or transitions to the submerged condition.

The following is a discussion of each portion of the HGL prediction equations.

TEST 1

=IF($BE255="NE",$H255,IF(BI255<=$I255,IF($BB255="NE",VLOOKUP(($AI255/$S255),'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12)+$N255,IF($BB255<=$BF$1,BF255*$P255+$I255,VLOOKUP(($AI255/$S255),'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12)+$N255)),IF((BF255*$P255+BI255)<$H255,VLOOKUP(($AI255/$S255),'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12)+$N255,BF255*$P255+BI255)))

Test 1 determines if the pipeline is to be paralleled at some future date. If BE=NE (not exceeded) then the pipeline in question is paralleled and no capacity limitations are expected. The upstream pipeline crown elevation is used as the upstream elevation. It is beyond the scope of this investigation to determine how the parallel pipes will operate. Therefore, the crown elevation of the pipe is used as the water surface elevation.

TEST 2

=IF($BE255="NE",$H255,**IF(BI255<=$I255**,IF($BB255="NE",VLOOKUP(($AI255/$S255),'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12) +$N255,IF($BB255<=$BF$1,BF255*$P255 + $I255, VLOOKUP(($AI255/$S255),'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12)+$N255)), IF((BF255*$P255+BI255)<$H255,VLOOKUP(($AI255/$S255),

'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12)+$N255, BF255*$P255+BI255)))

Test 2 determines if the downstream water surface elevation is less than or equal to the crown elevation of the pipe. If the test fails, a surcharge condition exists. If a surcharge condition exists, the last portion of the equation is used and is discussed in Test 6. If the test passes, the equation performs Test 3.

TEST 3

=IF($BE255="NE",$H255,IF(BI255<=$I255,**IF($BB255="NE",VLOOKUP(($AI255/$S255),'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12) +$N255**,IF($BB255<=$BF$1,BF255*$P255 + $I255, VLOOKUP(($AI255/$S255),'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12)+$N255)), IF((BF255*$P255+BI255)<$H255,VLOOKUP(($AI255/$S255),

'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12)+$N255, BF255*$P255+BI255)))

Test 3 determines if the capacity of the pipe is not exceeded (NE) within the study period (2050). If the capacity is not exceeded, a partial flow calculation is performed. In the partial flow calculation, the decade flow rate in question is divided by the total capacity of the pipeline (q/Q). The result of this calculation is used to look up the partial flow diameter divided by the total diameter of the pipe (d/D). The lookup table is included in the worksheet. This ratio is used to calculate the depth of flow (d) in the section of pipe by multiplying the diameter ratio by the pipeline diameter ((d/D) x D = d).

TEST 4

=IF($BE255="NE",$H255,IF(BI255<=$I255,IF($BB255="NE",VLOOKUP(($AI255/$S255),'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12) +$N255,**IF($BB255<=$BF$1,BF255*$P255 + $I255**, VLOOKUP(($AI255/$S255),'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12)+$N255)), IF((BF255*$P255+BI255)<$H255,VLOOKUP(($AI255/$S255),

'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12)+$N255, BF255*$P255+BI255)))

If test 3 fails, the equation checks to see if the decade the pipe capacity is exceeded is less than or equal to the decade in question. If this statement is true, the pipe transitions from gravity to the submerged condition at some point in the section of pipe. A full pipe calculation is used to predict the water surface profile [Sf=(n2*Q2)/(2.22*A2*R4/3)] where n=0.013. This equation determines the slope of the hydraulic grade line (HGL). The

upstream water surface elevation can be found when the result is multiplied by the length of pipeline and added to the downstream water surface elevation. Applying this equation to the total length of the pipeline is not completely accurate as the length of submerged pipe is less than the total length of pipe if the pipe transition from gravity to submerged flow. However, it is a conservative estimate of the HGL because a higher elevation is obtained resulting in a slightly higher submerged depth.

TEST 5

=IF($BE255="NE",$H255,IF(BI255<=$I255,IF($BB255="NE",VLOOKUP(($AI255/$S255),'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12) +$N255,IF($BB255<=$BF$1,BF255*$P255 + $I255, **VLOOKUP(($AI255/$S255),'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12)+$N255)),** IF((BF255*$P255+BI255)<$H255,VLOOKUP(($AI255/$S255),

'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12)+$N255, BF255*$P255+BI255)))

If test 5 fails, the capacity of the pipeline is not exceeded within the study period and a partial flow calculation is performed as described in Test 3.

TEST 6

=IF($BE255="NE",$H255,IF(BI255<=$I255,IF($BB255="NE",VLOOKUP(($AI255/$S255),'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12) +$N255,IF($BB255<=$BF$1,BF255*$P255 + $I255, VLOOKUP(($AI255/$S255),'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12)+$N255)), **IF((BF255*$P255+BI255)<$H255,VLOOKUP(($AI255/$S255),**

'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12)+$N255, BF255*$P255+BI255)))

Test 6 is applied only if the downstream portion of pipe is submerged. The first portion of test 6 is applied if the pipe transitions from submerged to gravity flow. If this transition occurs, the partial flow calculation is used to predict the water surface elevation as described in Test 3.

=IF($BE255="NE",$H255,IF(BI255<=$I255,IF($BB255="NE",VLOOKUP(($AI255/$S255),'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12) +$N255,IF($BB255<=$BF$1,BF255*$P255 + $I255, VLOOKUP(($AI255/$S255),'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12)+$N255)), IF((BF255*$P255+BI255)<$H255,VLOOKUP(($AI255/$S255),

'Partial Pipe Flow'!$D$7:$G$17,2)*($J255/12)+$N255, BF255*$P255+BI255)))

If the pipe does not transition from submerged to gravity flow, the full pipe flow calculation is used to calculate the slope of the HGL [Sf=(n2*Q2)/(2.22*A2*R4/3)]. The slope is multiplied by the pipe length and added to the downstream water surface elevation to obtain the upstream water surface elevation.

BE255=Cell referenced to determine if pipeline is to be paralleled
H255=Crown Elevation Upstream (ft)
BI255=Upstream Water Elevation (ft) 2010
I255=Crown Elevation Downstream (ft)
BB255=Decade Exceeded
AI255=2010 Total Design Flow (MGD)
S255=Capacity of pipe (MGD)
'Partial Pipe Flow'D7:G17=q/Q values which relate to d/D values
J255=Pipe Diameter (in)
N255=Upstream Invert Elevation (ft)
$BF$1=2010
BF255=Slope of Submerged HGL
P255 =Length of Pipe (ft)

APPENDIX D

Revised Working Alternatives Construction Cost Estimates

Cost Calculations for Project: **Revised Working Alternative - Kent**

Project year: 2003

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.).

Assumptions

Project Year: 2003
Comments:

Sub Items

Name	Type	Year	Cost	Multiplier	2003 Cost
aub1	Pipe	2003	7,737,291.98	1.00	7,737,291.98
aub2 (part a)	Pipe	2003	7,378,005.16	1.00	7,378,005.16
aub2 (part b)	Pipe	2003	10,423,770.63	1.00	10,423,770.63
aub3	Pipe	2003	8,196,812.60	1.00	8,196,812.60
Mill Creek Relief	Pipe	2003	2,249,069.69	1.00	2,249,069.69
				Subtotal	35,984,950.05

Total: $35,984,950.05

Cost Calculations for Pipe: **aub1**

Project year: 2003

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.).

Assumptions

Construction Year: 2003
Length: 3799 ft
Conduit Type: Gravity Sewer
Depth of Cover: 20 ft

Trench Backfill Type: Native
Manhole Spacing: Average (500 ft)
Existing Utilities: Complex
Dewatering: Significant
Pavement Restoration: Trench Width
Traffic: Heavy
Land Acquisition: None
Required Easements: None
Trench Safety: Standard
Pipe Diameter: 108 in.

Geometry

Outer Diameter	10.667 ft
Trench Width	16.367 ft
Excavation Depth	31.667 ft
Complete Surface Rest. Width	18.367 ft

Unit Costs (Basis 1999)

Item	Quantity	Unit	Unit Cost	ItemCost
Excavation	72,923.60	CY	10.00	729,236.03
Backfill	43,754.16	CY	5.00	218,770.81
Complete Pavement Restoration	7,752.77	SY	50.00	387,638.70
Trench Safety	240,603.33	SF	0.50	120,301.67
Spoil Load and Haul	29,169.44	CY	10.00	291,694.41
Pipe Unit Material Cost	3,799.00	lf	540.00	2,051,460.00
Pipe Installation	3,799.00	lf	280.00	1,063,720.00
Place Pipe Zone Fill	16,596.04	CY	25.00	414,900.94
Manholes	8.00	MH	48,000.00	384,000.00
Existing Utilities	3,799.00	lf	300.00	1,139,700.00
Dewatering	3,799.00	lf	120.00	455,880.00
Traffic Control	3,799.00	lf	50.00	189,950.00
			Year 1999 subtotal	7,447,252.56

Mobilization/Demobilization at 10%	1.10
Multiplier from ENRCCI 7137 (1999) to 6741 (2003)	0.94
Effective Multiplier	1.04
Subtotal	7,737,291.98

Total: $7,737,291.98

Cost Calculations for Pipe: **aub2 (part a)**

Project year: 2003

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.).

Assumptions

- Construction Year: 2003
- Length: 3613 ft
- Conduit Type: Gravity Sewer
- Depth of Cover: 20 ft
- Trench Backfill Type: Native
- Manhole Spacing: Average (500 ft)
- Existing Utilities: Complex
- Dewatering: Significant
- Pavement Restoration: Trench Width
- Traffic: Heavy
- Land Acquisition: None
- Required Easements: None
- Trench Safety: Standard
- Pipe Diameter: 108 in.

Geometry

Outer Diameter	10.667 ft
Trench Width	16.367 ft

Excavation Depth	31.667 ft
Complete Surface Rest. Width	18.367 ft

Unit Costs (Basis 1999)

Item	Quantity	Unit	Unit Cost	ItemCost
Excavation	69,353.24	CY	10.00	693,532.45
Backfill	41,611.95	CY	5.00	208,059.73
Complete Pavement Restoration	7,373.20	SY	50.00	368,659.81
Trench Safety	228,823.33	SF	0.50	114,411.67
Spoil Load and Haul	27,741.30	CY	10.00	277,412.98
Pipe Unit Material Cost	3,613.00	lf	540.00	1,951,020.00
Pipe Installation	3,613.00	lf	280.00	1,011,640.00
Place Pipe Zone Fill	15,783.49	CY	25.00	394,587.28
Manholes	8.00	MH	48,000.00	384,000.00
Existing Utilities	3,613.00	lf	300.00	1,083,900.00
Dewatering	3,613.00	lf	120.00	433,560.00
Traffic Control	3,613.00	lf	50.00	180,650.00
		Year 1999 subtotal		7,101,433.93

Mobilization/Demobilization at 10%	1.10
Multiplier from ENRCCI 7137 (1999) to 6741 (2003)	0.94
Effective Multiplier	1.04
Subtotal	7,378,005.16

Total: $7,378,005.16

Cost Calculations for Pipe: **aub2 (part b)**

Project year: 2003

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.).

Assumptions

Construction Year: 2003
Length: 5034 ft
Conduit Type: Gravity Sewer
Depth of Cover: 22 ft
Trench Backfill Type: Native
Manhole Spacing: Average (500 ft)
Existing Utilities: Complex
Dewatering: Significant
Pavement Restoration: Trench Width
Traffic: Heavy
Land Acquisition: None
Required Easements: None
Trench Safety: Standard
Pipe Diameter: 108 in.

Geometry

Outer Diameter	10.667 ft
Trench Width	16.367 ft
Excavation Depth	33.667 ft
Complete Surface Rest. Width	18.367 ft

Unit Costs (Basis 1999)

Item	Quantity	Unit	Unit Cost	ItemCost
Excavation	102,732.96	CY	10.00	1,027,329.60
Backfill	64,080.96	CY	5.00	320,404.78
Complete Pavement Restoration	10,273.09	SY	50.00	513,654.44
Trench Safety	338,956.00	SF	0.50	169,478.00
Spoil Load and Haul	38,652.00	CY	10.00	386,520.05
Pipe Unit Material Cost	5,034.00	lf	540.00	2,718,360.00
Pipe Installation	5,034.00	lf	280.00	1,409,520.00
Place Pipe Zone Fill	21,991.17	CY	25.00	549,779.24
Manholes	11.00	MH	52,000.00	572,000.00
Existing Utilities	5,034.00	lf	300.00	1,510,200.00

Dewatering	5,034.00	lf	120.00	604,080.00
Traffic Control	5,034.00	lf	50.00	251,700.00
			Year 1999 subtotal	10,033,026.11

Mobilization/Demobilization at 10%	1.10
Multiplier from ENRCCI 7137 (1999) to 6741 (2003)	0.94
Effective Multiplier	1.04
Subtotal	10,423,770.63

Total: $10,423,770.63

Cost Calculations for Pipe: **aub3**

Project year: 2003

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.).

Assumptions

Construction Year: 2003
Length: 4107 ft
Conduit Type: Gravity Sewer
Depth of Cover: 17 ft
Trench Backfill Type: Native
Manhole Spacing: Average (500 ft)
Existing Utilities: Complex
Dewatering: Significant
Pavement Restoration: Trench Width
Traffic: Heavy
Land Acquisition: None
Required Easements: None
Trench Safety: Standard

Pipe Diameter: 108 in.

Geometry

Outer Diameter	10.667 ft
Trench Width	16.367 ft
Excavation Depth	28.667 ft
Complete Surface Rest. Width	18.367 ft

Unit Costs (Basis 1999)

Item	Quantity	Unit	Unit Cost	ItemCost
Excavation	71,367.15	CY	10.00	713,671.53
Backfill	39,832.83	CY	5.00	199,164.15
Complete Pavement Restoration	8,381.32	SY	50.00	419,066.11
Trench Safety	235,468.00	SF	0.50	117,734.00
Spoil Load and Haul	31,534.32	CY	10.00	315,343.23
Pipe Unit Material Cost	4,107.00	lf	540.00	2,217,780.00
Pipe Installation	4,107.00	lf	280.00	1,149,960.00
Place Pipe Zone Fill	17,941.54	CY	25.00	448,538.60
Manholes	9.00	MH	42,000.00	378,000.00
Existing Utilities	4,107.00	lf	300.00	1,232,100.00
Dewatering	4,107.00	lf	120.00	492,840.00
Traffic Control	4,107.00	lf	50.00	205,350.00
		Year 1999 subtotal		7,889,547.63

Mobilization/Demobilization at 10%	1.10
Multiplier from ENRCCI 7137 (1999) to 6741 (2003)	0.94
Effective Multiplier	1.04
Subtotal	8,196,812.60

Total: $8,196,812.60

Cost Calculations for Pipe: **Mill Creek Relief**

Project year: 2003

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.).

Assumptions

Construction Year: 2003
Length: 3920 ft
Conduit Type: Gravity Sewer
Depth of Cover: 20 ft
Trench Backfill Type: Native
Manhole Spacing: Average (500 ft)
Existing Utilities: Complex
Dewatering: Significant
Pavement Restoration: Trench Width
Traffic: Heavy
Land Acquisition: None
Required Easements: None
Trench Safety: Standard
Pipe Diameter: 36 in.

Geometry

Outer Diameter	3.667	ft
Trench Width	7.267	ft
Excavation Depth	24.667	ft
Complete Surface Rest. Width	9.267	ft

Unit Costs (Basis 1999)

Item	Quantity	Unit	Unit Cost	ItemCost
Excavation	26,023.64	CY	10.00	260,236.38
Backfill	20,045.23	CY	5.00	100,226.17
Complete Pavement Restoration	4,036.15	SY	50.00	201,807.41
Trench Safety	193,386.67	SF	0.50	96,693.33

Spoil Load and Haul	5,978.40	CY	10.00	59,784.03
Pipe Unit Material Cost	3,920.00	lf	60.00	235,200.00
Pipe Installation	3,920.00	lf	54.00	211,680.00
Place Pipe Zone Fill	4,445.36	CY	25.00	111,133.94
Manholes	8.00	MH	13,000.00	104,000.00
Existing Utilities	3,920.00	lf	100.00	392,000.00
Dewatering	3,920.00	lf	80.00	313,600.00
Traffic Control	3,920.00	lf	20.00	78,400.00
		Year 1999 subtotal		2,164,761.27

Mobilization/Demobilization at 10%	1.10
Multiplier from ENRCCI 7137 (1999) to 6741 (2003)	0.94
Effective Multiplier	1.04
Subtotal	2,249,069.69

Total: $2,249,069.69

Cost Calculations for Project: **Revised Working Alternative - Auburn**

Project year: 2003

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.).

Assumptions

Project Year: 2003
Comments:

Sub Items

Name	Type	Year	Cost	Multiplier	2003 Cost
AWVAL (part A)	Pipe	2003	2,023,833.05	1.00	2,023,833.05
AWVAL (part B)	Pipe	2003	4,873,871.41	1.00	4,873,871.41
AWVAL (part c)	Pipe	2003	6,750,149.90	1.00	6,750,149.90
Stuck River	Pipe	2003	2,839,214.08	1.00	2,839,214.08
				Subtotal	16,487,068.45

Total: $16,487,068.45

Cost Calculations for Pipe: **AWVAL (part A)**

Project year: 2003

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.).

Assumptions

Construction Year: 2003
Length: 3770 ft
Conduit Type: Gravity Sewer
Depth of Cover: 14 ft
Trench Backfill Type: Native

Manhole Spacing: Average (500 ft)
Existing Utilities: Complex
Dewatering: Significant
Pavement Restoration: Trench Width
Traffic: Heavy
Land Acquisition: None
Required Easements: None
Trench Safety: Standard
Pipe Diameter: 36 in.

<u>Geometry</u>

Outer Diameter	3.667	ft
Trench Width	7.267	ft
Excavation Depth	18.667	ft
Complete Surface Rest. Width	9.267	ft

<u>Unit Costs (Basis 1999)</u>

Item	Quantity	Unit	Unit Cost	ItemCost
Excavation	18,939.98	CY	10.00	189,399.84
Backfill	13,190.35	CY	5.00	65,951.73
Complete Pavement Restoration	3,881.70	SY	50.00	194,085.19
Trench Safety	140,746.67	SF	0.50	70,373.33
Spoil Load and Haul	5,749.64	CY	10.00	57,496.38
Pipe Unit Material Cost	3,770.00	lf	60.00	226,200.00
Pipe Installation	3,770.00	lf	54.00	203,580.00
Place Pipe Zone Fill	4,275.25	CY	25.00	106,881.37
Manholes	8.00	MH	10,000.00	80,000.00
Existing Utilities	3,770.00	lf	100.00	377,000.00
Dewatering	3,770.00	lf	80.00	301,600.00
Traffic Control	3,770.00	lf	20.00	75,400.00
		Year 1999 subtotal		1,947,967.83

Mobilization/Demobilization at 10% 1.10

Multiplier from ENRCCI 7137 (1999) to 6741 (2003)	0.94
Effective Multiplier	1.04
Subtotal	2,023,833.05

Total: $2,023,833.05

Cost Calculations for Pipe: **AWVAL (part B)**

Project year: 2003

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.).

Assumptions

Construction Year: 2003
Length: 5878 ft
Conduit Type: Gravity Sewer
Depth of Cover: 16 ft
Trench Backfill Type: Native
Manhole Spacing: Average (500 ft)
Existing Utilities: Complex
Dewatering: Significant
Pavement Restoration: Trench Width
Traffic: Heavy
Land Acquisition: None
Required Easements: None
Trench Safety: Standard
Pipe Diameter: 54 in.

Geometry

Outer Diameter	5.542	ft
Trench Width	9.704	ft
Excavation Depth	22.542	ft

Complete Surface Rest. Width 11.704 ft

Unit Costs (Basis 1999)

Item	Quantity	Unit	Unit Cost	ItemCost
Excavation	47,622.27	CY	10.00	476,222.69
Backfill	31,689.50	CY	5.00	158,447.48
Complete Pavement Restoration	7,644.12	SY	50.00	382,206.06
Trench Safety	264,999.83	SF	0.50	132,499.92
Spoil Load and Haul	15,932.77	CY	10.00	159,327.74
Pipe Unit Material Cost	5,878.00	lf	150.00	881,700.00
Pipe Installation	5,878.00	lf	100.00	587,800.00
Place Pipe Zone Fill	10,681.84	CY	25.00	267,046.02
Manholes	12.00	MH	19,600.00	235,200.00
Existing Utilities	5,878.00	lf	120.00	705,360.00
Dewatering	5,878.00	lf	90.00	529,020.00
Traffic Control	5,878.00	lf	30.00	176,340.00
		Year 1999 subtotal		4,691,169.91

Mobilization/Demobilization at 10%	1.10
Multiplier from ENRCCI 7137 (1999) to 6741 (2003)	0.94
Effective Multiplier	1.04
Subtotal	4,873,871.41

Total: $4,873,871.41

Cost Calculations for Pipe: **AWVAL (part c)**

Project year: 2003

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.).

Assumptions

Construction Year: 2003
Length: 11440 ft
Conduit Type: Gravity Sewer
Depth of Cover: 15 ft
Trench Backfill Type: Native
Manhole Spacing: Average (500 ft)
Existing Utilities: Complex
Dewatering: Significant
Pavement Restoration: Trench Width
Traffic: Heavy
Land Acquisition: None
Required Easements: None
Trench Safety: Standard
Pipe Diameter: 42 in.

Geometry

Outer Diameter	4.25	ft
Trench Width	8.025	ft
Excavation Depth	20.25	ft
Complete Surface Rest. Width	10.025	ft

Unit Costs (Basis 1999)

Item	Quantity	Unit	Unit Cost	ItemCost
Excavation	68,854.50	CY	10.00	688,545.00
Backfill	47,603.11	CY	5.00	238,015.56
Complete Pavement Restoration	12,742.89	SY	50.00	637,144.44
Trench Safety	463,320.00	SF	0.50	231,660.00
Spoil Load and Haul	21,251.39	CY	10.00	212,513.89
Pipe Unit Material Cost	11,440.00	lf	78.00	892,320.00
Pipe Installation	11,440.00	lf	60.00	686,400.00
Place Pipe Zone Fill	15,240.62	CY	25.00	381,015.51
Manholes	23.00	MH	10,500.00	241,500.00
Existing Utilities	11,440.00	lf	100.00	1,144,000.00

Dewatering	11,440.00	lf	80.00	915,200.00
Traffic Control	11,440.00	lf	20.00	228,800.00
			Year 1999 subtotal	6,497,114.40

Mobilization/Demobilization at 10%	1.10
Multiplier from ENRCCI 7137 (1999) to 6741 (2003)	0.94
Effective Multiplier	1.04
Subtotal	6,750,149.90

Total: $6,750,149.90

Cost Calculations for Pipe: **Stuck River**

Project year: 2003

The estimated construction cost below, which includes contractor overhead and profit, is for planning purposes only. The output does NOT include contingency, sales tax, or allied costs (design, permitting, construction management, etc.).

Assumptions

Construction Year: 2003
Length: 6359 ft
Conduit Type: Gravity Sewer
Depth of Cover: 12 ft
Trench Backfill Type: Native
Manhole Spacing: Average (500 ft)
Existing Utilities: Complex
Dewatering: Significant
Pavement Restoration: Trench Width
Traffic: Heavy
Land Acquisition: None
Required Easements: None
Trench Safety: Standard

Pipe Diameter: 30 in.

Geometry

Outer Diameter	3.083	ft
Trench Width	6.508	ft
Excavation Depth	16.083	ft
Complete Surface Rest. Width	8.508	ft

Unit Costs (Basis 1999)

Item	Quantity	Unit	Unit Cost	ItemCost
Excavation	24,653.06	CY	10.00	246,530.64
Backfill	16,861.16	CY	5.00	84,305.82
Complete Pavement Restoration	6,011.61	SY	50.00	300,580.51
Trench Safety	204,547.83	SF	0.50	102,273.92
Spoil Load and Haul	7,791.90	CY	10.00	77,919.01
Pipe Unit Material Cost	6,359.00	lf	50.00	317,950.00
Pipe Installation	6,359.00	lf	40.00	254,360.00
Place Pipe Zone Fill	6,033.35	CY	25.00	150,833.66
Manholes	13.00	MH	9,000.00	117,000.00
Existing Utilities	6,359.00	lf	80.00	508,720.00
Dewatering	6,359.00	lf	70.00	445,130.00
Traffic Control	6,359.00	lf	20.00	127,180.00
		Year 1999 subtotal		2,732,783.56

Mobilization/Demobilization at 10%	1.10
Multiplier from ENRCCI 7137 (1999) to 6741 (2003)	0.94
Effective Multiplier	1.04
Subtotal	2,839,214.08

Total: $2,839,214.08